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DEPARTMENT OF THE ARMY FIELD MANUAL

FM 23-81

This manual supersedes those portions of Training Circulars No. 25, War Department, 1945, and No. 11, War Department, 1946, pertaining to the 75-mm rifle.

75-mm RIFLE

M20

DEPARTMENT OF THE ARMY • MARCH 1948

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FM 23–81, 75-mm Rifle, M20, is published for the information and guidance of all concerned.

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This manual supersedes those portions of Training Circulars No. 25, War Department, 1945, and No. 11, War Department, 1946, pertaining to the 75-mm rifle.

CHAPTER 1
INTRODUCTION

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1. PURPOSE AND SCOPE. a. This manual provides the unit commander with the data necessary for the step-by-step training of gun crews equipped with the 75-mm rifle, M20.

b. The scope of this manual includes mechanical training, training for placing the gun in action, marksmanship, and the techniques of direct and indirect fire.

2. DESCRIPTION. a. The 75-mm rifle, M20 (fig. 1), is a recoilless portable weapon designed to be fired from the machine gun tripod mount caliber .30, M1917A1. It is an air cooled, single shot, breech loading weapon using fixed ammunition. This rifle is equipped with a manually operated breech mechanism and a percussion type firing mechanism.

b. Tabulated data. (1) *General.*

Weight of rifle (w/sight bracket)	lbs	114.5
Weight of rifle complete w/mount and sight bracket	lbs	167.7
Length of rifle	in	82
Length of tube	in	65.1
Length of rifling	in	65.1
Type of breechblock		Interrupted screw

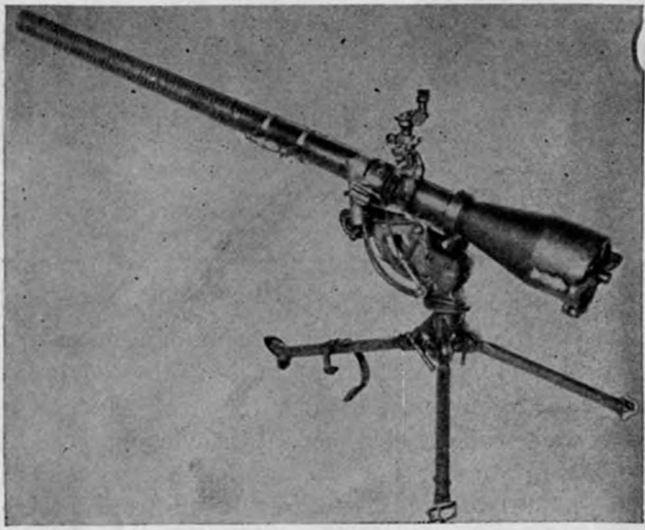


Figure 1. 75-mm rifle M20 (mounted on HMG tripod).

(2) *Performance.*

Muzzle velocity HE and WP	f/s	990
Muzzle velocity HEAT	f/s	1000
Range (approximate maximum):		
Cartridge, HEAT, N310 (T39), for 75-mm rifle, M20	yds	7200
Cartridge, HE, M309 (T38), for 75-mm rifle, M20	yds	6955
Cartridge, SMOKE, WP, M311 (T40), for 75-mm rifle, M20	yds	7020

c. Data pertaining to mount M1917A1. See FM 23–55.

d. Sighting equipment: (1) Unit sight, M34 (for indirect fire), consists of—

Elevation quadrant.

Telescope adapter.
Elbow telescope.
Instrument light.
Carrying case.

(2) Direct fire sight, M85C, consists of—
Telescope mount.
Telescope.
Instrument light.
Carrying case.

3. PRINCIPLE OF OPERATION. The shell casing for recoilless rifle ammunition is perforated so that the propellant gases can escape through the perforations into the enlarged chamber of the tube. The breech is so constructed that, on ignition of the propellant charge, the resultant gases are allowed to escape to the rear through orifices in the breechblock, thereby eliminating recoil. The gas escape orifices are so designed that the momentum of gas discharge effectively counteracts the momentum of recoil and the angular momentum induced by the motion of the fired shell, and the rifle remains motionless.

CHAPTER 2

MECHANICAL TRAINING

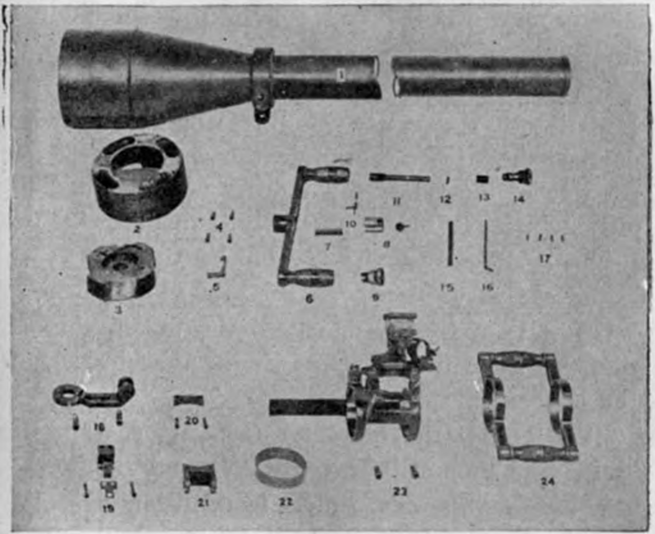
Section I. DISASSEMBLY AND ASSEMBLY

4. GENERAL. A knowledge of the procedure of disassembly and assembly is a prerequisite to an understanding of functioning and stoppages, and to an ability to perform immediate action to reduce stoppages. The process of normal care and cleaning also requires a knowledge of these subjects. The following paragraphs outline a standardized, step-by-step method of disassembly and assembly.

5. DISASSEMBLY (fig. 2). The Allen wrenches contained in the breech handle are the only tools needed to field strip the rifle. The preliminary steps and the disassembly of the parts are accomplished in the order indicated below.

a. Disengage the breech lock, open the breech and check the chamber to see that it is clear. With the breech in the open position, rotate the safety and depress the trigger. Holding the trigger depressed, close the breech. This places the hammer and firing spring in the "as fired" position.

b. Remove the two breech operating handle housing screws on the left side of the breech operating handle housing, and remove the lower screw on the right side. Holding the right hand in position to catch the closed breech lock spring in the event that it springs out of its seat, remove



1. Tube chamber assembly.
2. Vent bushing.
3. Breechblock.
4. Breech operating handle housing screws.
5. Extractor and extractor spring.
6. Breech operating handle assembly.
7. Firing spring.
8. Hammer and firing pin.
9. Breech handle cap.
10. Closed breech lock and spring.
11. Trigger.
12. Trigger pin.
13. Trigger spring.
14. Safety.
15. Sear cover.
16. Sear.
17. Cam rollers.
18. Breech hinge, hinge pin and hinge pin screw.
19. Breech hinge block, shim and screws.
20. } Front mounting bracket
21. } and screws.
22. Front mounting bracket ring.
23. Telescope mount and screws.
24. Tube handle assembly.

Figure 2. 75-mm rifle, M20—disassembled.

the remaining screw, and remove the breech operating handle housing assembly.

c. Remove the closed breech lock and spring.

d. Remove the firing pin, hammer assembly, and the firing spring from the hammer housing.

e. Remove the two cam rollers from the hammer housing.

f. Lift out the sear cover.

g. Rotate the safety ¼ turn counterclockwise, depress the trigger, continue the counterclockwise rotation of the safety for another ¼ turn, then lift out the trigger safety assembly, being careful not to displace the trigger key from its recess.

h. Remove the sear.

i. Rotate the breechblock to the unlocked position and open the breech. Lift the breechblock off the hinge.

j. Withdraw the extractor from its seat in the hinge, and then withdraw the extractor spring.

k. Remove the cam rollers from the hinge.

l. Remove the hinge pin screw from the hinge block and remove the hinge pin by pushing it out of the block.

m. The weapon is now stripped for normal care and cleaning. There are three additional disassemblies which may be undertaken, under competent supervision, for periodic cleaning. They are:

(1) *Separation of firing pin from hammer.* Insert hammer into its seat in the housing, making sure that the square slots in the hammer engage the cam rollers. While supporting housing with one

hand unscrew the firing pin from hammer using the spanner wrench.

(2) *Removal of breechblock hinge.* Rotate hinge upward to uncover the hinge block screw. Using small wrench unscrew the hinge block screw. Disengage the hinge from the hinge block by removing the hinge pin.

(3) *Disassembly of the trigger and safety assembly.* (*a*) While holding the base of the trigger, slightly pull up and rotate the trigger safety, and allow the trigger key to drop out of the trigger.

(*b*) Holding trigger safety in left hand, with the trigger spring down, place corner of cover plate against the end of trigger spring. Exert pressure against the end of spring to prevent it from turning. Rotate trigger safety counterclockwise and unscrew it from trigger spring. Withdraw trigger safety from trigger.

(*c*) Hold trigger in left hand and, using the same procedure as outlined in (*b*) above, remove trigger spring from trigger.

n. The removal of tube carrying handles, the mounting bracket, and the telescope mount may be accomplished, under competent supervision, by loosening or unscrewing the proper clamping or holding screws.

o. The vent bushing is screwed into the rear end of the chamber and locked in place by the hinge pin screw which passes through the chamber wall into a hole in the bushing. The cone and the interrupted threads, which engage the breechblock, are an integral part of the bushing. These parts may be removed by ordnance maintenance personnel only.

6. **ASSEMBLY.** Assembly is in approximately the reverse order of disassembly.

a. Place the hinge in position so that it straddles the hinge block, and insert the hinge pin so that the notch in the pin faces to the rear.

b. Insert and tighten the hinge pin screw making certain that the point on the screw enters the hole in the vent bushing.

c. Replace the cam rollers in the hinge.

d. Insert the extractor spring into its recess in the hinge. This spring may be inserted with the curved surface either up or down.

e. Insert the extractor into the recess in the hinge so that the hook is pointing away from the hinge block.

f. Place the breechblock on the hinge making certain that the projection on the lower end of the extractor enters the cam slot in the breechblock.

g. Close the breech and rotate the breechblock to the locked position.

h. Replace the sear in its slot in the breech operating handle housing so that the tapered end is toward the hammer housing and the bent end is in the trigger handle.

i. Insert the trigger and safety assembly into the trigger handle so that the studs of the safety become engaged in the slots in the trigger handle. Revolve the trigger key clockwise until it is lined up with the lugs on the safety. In order to complete this operation it is necessary to depress the trigger. Before this assembly can be fully seated in the trigger handle, the sear recess in the base of the trigger must be in position to receive the bent end of the sear. When the assembly is completely seated, the safety will revolve and retain the assembly.

j. Place the sear cover, curved end up, over the sear slot in the breech operating handle housing.

k. Replace the two cam rollers in their recesses in the hammer housing.

l. Center the firing spring in the hammer housing. Place the hammer-firing pin assembly over the firing spring with the cam rollers positioned in the two square slots, and with the sear notch in position to engage the sear.

Caution: Be sure that the hammer is replaced so that the sear notch is opposite the sear. If the hammer is replaced backwards—that is, so that the sear notch is opposite the closed breech lock—the closed breech lock will engage the hammer in the cocked position when the piece is cocked. Manual operation of the closed breech lock will then release the hammer. This situation is extremely dangerous if the breech is closed on a live round, as the only way the breech may be reopened is by disengaging the closed breech lock manually.

m. Replace the closed breech lock and spring into their recess in the breech operating handle assembly.

n. Holding the closed breech lock pin, place the breech operating handle assembly against the breechblock so that the trigger handle is on the left.

o. Secure the assembly to the breechblock with the four breech operating handle assembly screws.

p. Replace tools in breech handle and replace breech handle cap.

q. Test by cocking the piece and actuating the firing mechanism.

Section II.

MECHANICAL FUNCTIONING

7. GENERAL. a. Introduction. A gun crew, to be efficient, must be able to keep its gun in action during combat. Therefore, in order to recognize the causes of mechanical failures, and to reduce the stoppages resulting therefrom, the crew must have a working knowledge of the mechanical functioning of the gun.

b. To unload. The gunner opens the breech by rotating the breechblock clockwise (using the trigger handle only) through an angle of approximately 45°, and then withdraws the breech assembly from the chamber. The loader grasps the partially extracted round by hand and ejects it.

c. To load. The loader inserts a round of ammunition into the chamber engaging the preengraved rotating band with the lands and grooves of the tube. The loader replaces the breechblock in the chamber and rotates it (using the breech handle only) counterclockwise to the locked position.

d. To fire the piece. The gunner rotates the safety clockwise (using either the index or middle finger of the right hand) as far as it will go, and then depresses the trigger with his thumb.

e. To clear the gun. The gunner opens the breech; the loader checks the chamber to see that the piece is unloaded. The piece is clear as long as the breech is open and the chamber is empty.

8. FUNCTIONING. For purposes of instruction, the subject of functioning is divided into three main headings which are: opening the breech, closing the breech, and firing the piece. Since functioning is a cycle, it is necessary to choose some point in the cycle from which to start. In the paragraphs on functioning which follow it is assumed that the piece has just been fired and that the empty shell case is still in the chamber. With this situation existing, successive steps in operation of the piece are—

a. Opening the breech (fig. 3). (1) *Cocking.* The cam rollers in the hammer housing hold the hammer so that when the breech operating handle assembly is rotated, the hammer must also rotate. The hammer is free to move horizontally back and forth independently of the breech operating handle assembly. When the breech operating handle assembly is properly positioned against the breechblock, the cam rollers in the hinge are lined up with the square slots in the hammer. When the breech operating handle assembly is rotated clockwise, the cocking cams on the hammer come into contact with the cam rollers in the hinge, and since these are immovable, the hammer is forced to the rear against the action of the firing spring. When the hammer has been cammed to the rear approximately one-half inch, the sear notch has moved into position so that the sear can be cammed to the right by the camming action of the oblique hole in the base of the trigger against the bent end of the sear. This camming action is actuated by the trigger spring which has a tendency to draw the base of the trigger up. The sear then enters the sear notch, and engages the hammer in the cocked position. When the breechblock has been rotated clockwise through approximately 45°, the piece has been cocked.

(2) *Unlocking.* When the breechblock has rotated clockwise through approximately 45°, the interrupted screws on the breechblock become disengaged or unscrewed from their locking surfaces in the chamber, and the breech is unlocked. Rotation is stopped when the right arm of the breech operating handle assembly comes in contact with the built-up portion of the hinge.

Note.—There are two unlocking actions. One is as described immediately above; the other is the disengaging of the closed breech lock from the hinge as described in **c**(1) below.

(3) *Extraction.* When the breechblock is in the closed and lock position, the hook of the extractor is positioned in front of and below the rim of the shell case. As the breech is rotated to the open position, the extractor is cammed upward by the camming action of the cam slot in the rear face of the breechblock against the large end of the extractor pin. This action so positions the extractor hook that

when the breechblock is swung to the rear, the hook engages the rim of the cartridge case, withdrawing it about two inches from the chamber before the hook is swung out of position by the downward movement.

(4) *Breech lock open.* The action of locking the breechblock, so that it may not be rotated while in the open position, is performed by the extractor arm. When the breech is open the extractor arm is forced into a recess in the rear of the breechblock by the action of the extractor spring, thereby locking the breechblock to the hinge. The purpose of this action is to insure that when the breechblock is placed into the chamber the threads on the breechblock will not burr against their locking surfaces in the chamber.

b. Closing the breech. (1) *Action of the breech lock open.* When the breechblock is closed the hook of the extractor first comes into contact with the rim of the shell case, or with the cone if the piece is not loaded, and is cammed away from the center of the breechblock against the action of the extractor spring. This camming action forces the arm of the extractor out of the recess in the rear of the breechblock, and thereby breaks the connection between the breechblock and the hinge, so that the breechblock is free to be rotated counterclockwise to the locked position.

(2) *Action of the extractor.* When the breechblock is fitted into the chamber, the extractor hook comes into contact with the rim of the shell case and is momentarily cammed to the side of the case. When the breechblock is fully seated, the extrac-

tor hook snaps into position in front of the rim of the shell case and remains there until the counterclockwise rotation of the breechblock is begun, at which time it is cammed downward by the action of the cam slot in the rear face of the breechblock acting against the large end of the extractor pin.

(3) *Locking.* When the breech is rotated counterclockwise the interrupted screws on the breechblock engage with their locking surfaces in the chamber. When this rotation is complete the cutaway portion of the breech lock cam on the hammer is in position to receive the small end of the closed breech lock. The small end of the closed breech lock is then forced into the cutaway portion of the closed breech lock cam by the action of the closed breech lock spring. When the closed breech lock is in this position, the shoulder of the lock bridges the gap between the breech operating handle assembly and the hinge, thereby preventing rotation of the breechblock. By moving the closed breech lock pin to the right, the breech can be unlocked without actuating the firing mechanism.

c. Firing the piece. (1) *Action of the firing mechanism* (fig. 3). The safety is a sleeve with slots in it. The slots are so arranged that the rotation of the safety alines the longitudinal slot with the trigger key so that the trigger may be depressed. As the trigger is depressed, the oblique hole (sear recess) in the base of the trigger acts as a cam against the bent end of the sear, camming the sear away from the hammer. As the sear becomes disengaged from the sear notch in the hammer, the hammer firing pin assembly moves forward under the action of the firing spring. (Rotation of the safety puts a tension on the trigger spring which tends to return the safety to its original position. Depression of the trigger also puts a tension on the trigger spring which tends to return the trigger to its original position. When the trigger is drawn up to the firing position the sear is cammed to the right. The trigger and safety do not return to their firing positions until the piece is recocked because the sear cannot be cammed to the firing position unless the sear notch is in position to receive the tapered end of the sear.) As the hammer goes forward, the closed breech lock cam on the hammer cams the closed breech lock to the right, disengaging the shoulder of the closed breech lock from its recess in the hinge, thus unlocking the block so that it is free to be rotated to the open position. The firing spring drives the hammer firing pin assembly forward so that the firing pin strikes the primer with sufficient force to detonate it, and the piece is fired.

(2) *Action of the gases.* When the propellant charge is detonated, a chemical reaction transforms the solid powder into a mass of hot gases which either ruptures or burns its way through the Kraft paper container within the shell case, and escapes through the perforations. The gases expand in all directions with equal force. The force exerted against the end of the projectile sends it through the tube. The force exerted in the opposite direction sends the gases through the gas escape orifices in the breechblock. The escape orifices are so

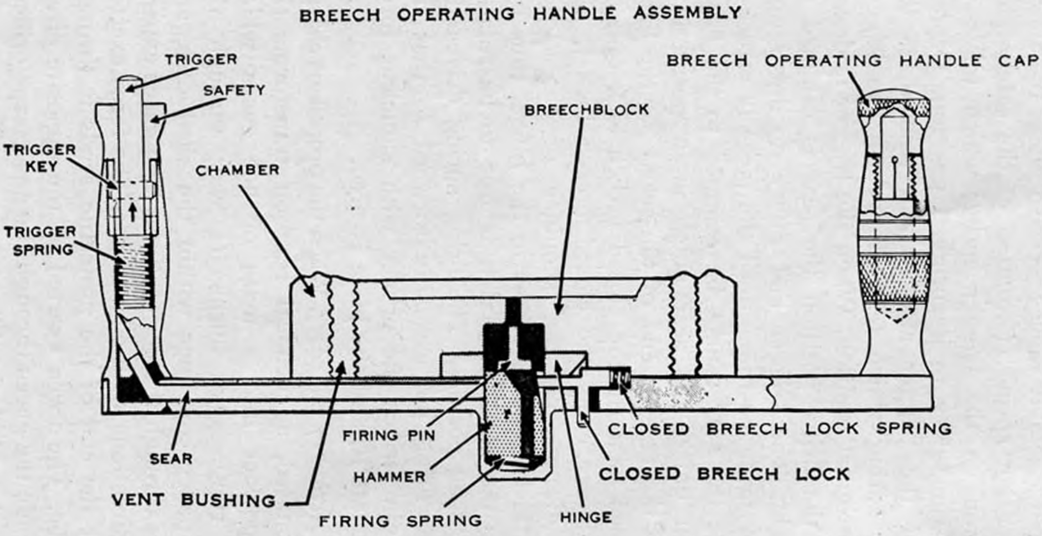

BREECH OPERATING HANDLE ASSEMBLY
TRIGGER
SAFETY
TRIGGER KEY
TRIGGER SPRING
CHAMBER
BREECHBLOCK
BREECH OPERATING HANDLE CAP
CLOSED BREECH LOCK SPRING
CLOSED BREECH LOCK
SEAR
FIRING PIN
HAMMER
VENT BUSHING
FIRING SPRING
HINGE

Figure 3. Cross section, breechblock and breech operating handle assembly, 75-mm rifle M20.

adjusted in size and shape that the forward and rearward thrusts acting on the tube chamber assembly neutralize each other. The orifices are also canted so that the gases are given a twisting motion to the rear. The resulting rotational thrust on the tube is equal and opposite to the rotational thrust caused by the action of the projectile against the rifling of the tube.

Section III. STOPPAGES AND IMMEDIATE ACTION

9. DEFINITIONS. a. A stoppage is any unintentional cessation of fire.

b. Immediate action is the unhesitating procedure used for the prompt elimination of common stoppages.

10. STOPPAGES. a. Prevention of stoppages. With a knowledge of functioning and care and cleaning the gunner can eliminate stoppages, to a large extent, by taking proper care of his piece and by performing detailed inspections from time to time. *Prevention is the best remedy for all stoppages.*

b. **Causes of stoppages.** Listed below are common stoppages and their usual causes. Although not considered stoppages in the literal sense of the word, two common malfunctions, forward movement and recoil, have been included at the end of the list. (See (6)(*a*) and (*b*) below.)

(1) *Failure to fire.* (*a*) Defective ammunition.

(*b*) Broken firing pin.

(*c*) Weak or broken firing spring.

(*d*) Carbon on firing pin shoulders.

(*e*) Carbon in firing pin recess.

(*f*) Breech not fully locked.

(*g*) Trigger frozen.

(*h*) Incorrect assembly of hammer.

(2) *Failure to cock.* (*a*) Weak, broken, or disconnected trigger spring.

(*b*) Insufficient rotation of breechblock.

(*c*) Cam rollers not replaced.

(3) *Failure of breech to open.* (*a*) Closed breech lock engaged with hinge (piece not fired).

(*b*) Incomplete rotation of breechblock.

(4) *Failure to extract.* (*a*) Broken or missing extractor spring.

(*b*) Broken extractor hook.

(*c*) Extractor frozen in position.

(5) *Failure of breech to close and lock.* (*a*) Broken or missing extractor spring allowing premature rotation of breechblock.

(*b*) Extractor frozen in position, allowing premature rotation of breechblock.

(*c*) Bent or improperly positioned extractor. (Extractor not alined with extractor clearance cut.)

(*d*) Preengraved rotating band burred causing improper positioning of round in chamber.

(*e*) Fouling in throat of tube causing improper positioning of round in chamber.

(*f*) Fouling of breechblock threads or locking surfaces.

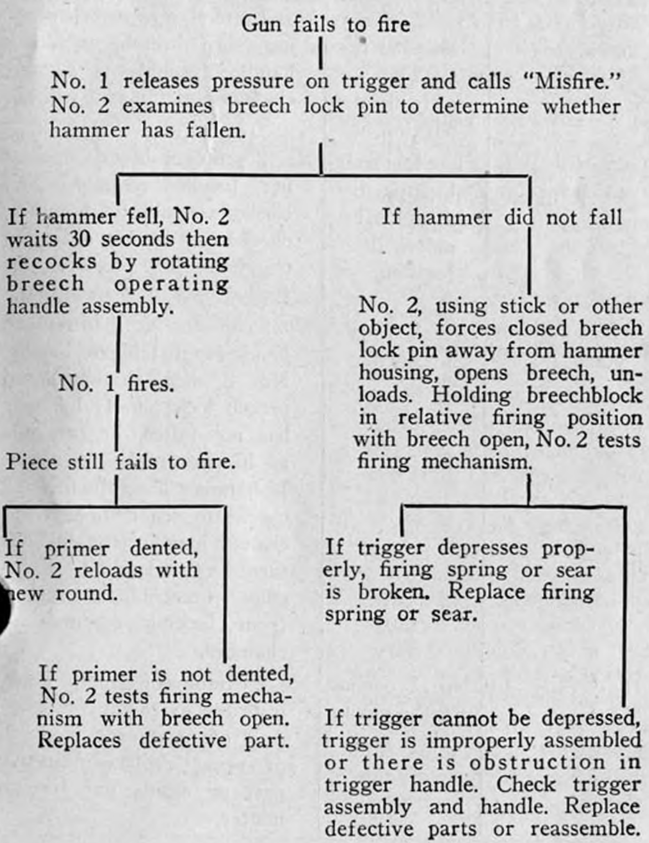
(*g*) Misalinement of threads because of shifted hinge block.

(6) *General malfunction of operation.* (*a*) Recoil when fired — obstruction in gas escape orifices.

(*b*) Forward movement when fired — gas escape orifices too large. (To be corrected by ordnance maintenance personnel only.)

11. REDUCTION OF STOPPAGES.

a. Immediate action.



Gun fails to fire

No. 1 releases pressure on trigger and calls "Misfire." No. 2 examines breech lock pin to determine whether hammer has fallen.

If hammer fell, No. 2 waits 30 seconds then recocks by rotating breech operating handle assembly.

No. 1 fires.

Piece still fails to fire.

If primer dented, No. 2 reloads with new round.

If primer is not dented, No. 2 tests firing mechanism with breech open. Replaces defective part.

If hammer did not fall

No. 2, using stick or other object, forces closed breech lock pin away from hammer housing, opens breech, unloads. Holding breechblock in relative firing position with breech open, No. 2 tests firing mechanism.

If trigger depresses properly, firing spring or sear is broken. Replace firing spring or sear.

If trigger cannot be depressed, trigger is improperly assembled or there is obstruction in trigger handle. Check trigger assembly and handle. Replace defective parts or reassemble.

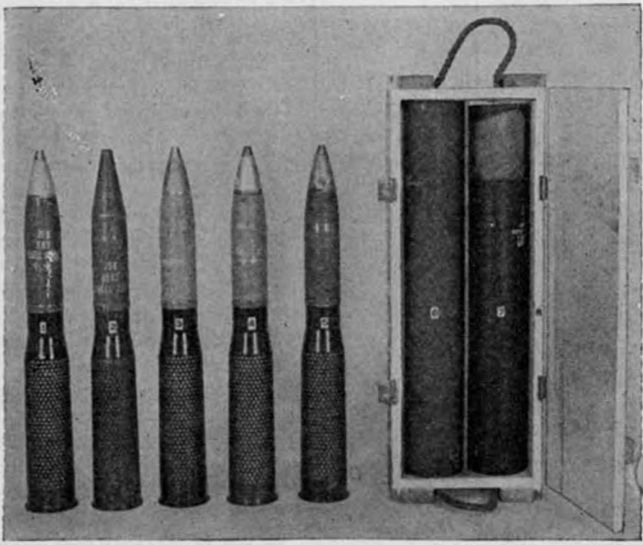
b. Uncommon stoppages. If the procedure outlined in **a** above does not place the gun in action, the gunner must inspect the working parts of the gun to locate and reduce the stoppage. Table below lists less common stoppages and actions by which the stoppage can be reduced.

Stoppage	Indication	Action
Gun fails to cock.	Closed breech lock pin remains in unlocked position.	No. 2 attempts to recock making sure breech operating handle assembly is rotated clockwise as far as it will go.
Gun still fails to cock.	Closed breech lock pin remains in unlocked position.	No. 2 removes breech operating handle assembly and checks assembly of hammer, checks cam rollers, sear, and trigger spring. Replaces defective part or reassembles.
Breech fails to open.	Breech fails to open.	No. 2 calls for No. 1 to remove hand from trigger handle. No. 2 then checks closed breech lock pin. If hammer has not fallen, he proceeds as in paragraph **10a** above. If hammer has fallen, No. 2 checks to see if breech operating handle assembly has turned far enough to disengage breechblock screws from locking surfaces i chamber.
Gun fails to extract.	No. 2 cannot grasp empty shell case.	No. 2 examines extractor hook, tests the extractor for freedom of movement, strength of spring; replaces defective part or cleans out foreign matter.

Stoppage	Indication	Action
reech fails to close and lock.	Breech fails to to close and lock.	No. 2 checks breechblock for premature rotation. Checks extractor for freedom of movement; checks to see if extractor is alined with extractor clearance cut; corrects extractor deficiencies by replacement or reassembly. If extractor is correct, No. 2 checks to see that ammunition is seated properly; checks fouling in throat of tube and on threads of breechblock and locking surface; cleans out fouling. If there is no fouling, No. 2 checks hinge block for proper position; if shifted, gun must be repaired by higher echelon.
Malfunction: gun recoils.	Gun recoils when fired.	No. 2 removes obstruction from gas escape orifices. (*Note.* New guns sometimes recoil slightly when first fired. When this is the case, recoil can be partially counterbalanced or taken up by reversing the tripod so that the trail leg is to the rear. Erosion of the vent bushing during normal firing will then balance the gun, after which the tripod should be returned to its original position. Caution must be observed to see that back blast does not undermine the trail leg when tripod is reversed).
Malfunction: gun moves forward when fired.	Gun moves forward when fired.	Vent bushing must be replaced by ordnance maintenance personnel.

Section IV. AMMUNITION AND FUZES

12. GENERAL. Ammunition for the 75-mm rifle, M20, is issued in the form of complete, fixed rounds (fig. 4). The round consists of a primer and propelling charge in a perforated case which is crimped rigidly to the projectile. The term "fixed" used in connection with ammunition signifies that the propelling charge is not adjustable and that the round is loaded into the weapon as a unit. The case is crimped rigidly to the projectile because the round



1. High explosive.
2. High explosive antitank.
3. Smoke, WP.
4. Target practice.
5. Inert.
6. Individual metal container.
7. Individual fiber container.
8. Packing box.

Figure 4. Ammunition for the 75-mm rifle, M20.

must be rotated in the chamber so that the preengraved rotating band can be fitted into the lands and grooves of the tube. Because of the preengraving on the rotating band, a lower chamber pressure is required to propel the round. The propellant is contained within the casing by a thin tube of Kraft paper. This paper is only 0.004″ thick; therefore, caution must be observed in handling the round to prevent rupture of this tube. Because of the incomplete protection against moisture afforded by the paper, added precautions must be taken to assure that the ammunition is kept dry. Each round comes packed in a waterproof, hermetically sealed container and should not be unpacked until ready for use. Each round weighs about 22 pounds. Each round in its individual container weighs 27 pounds. Two rounds in their wooden crate weigh 78 to 80 pounds.

13. TYPES (fig. 4). Depending upon the type of projecticle, ammunition for this rifle is classified as high explosive (HE), high explosive antitank (HEAT), white phosphorus (WP), inert (IN), and target practice (TP).

14. HIGH EXPLOSIVE. a. The HE projectile is a comparatively thin walled projectile containing high explosive bursting charge. It is used principally for fragmentation or mining effects. It has a total weight of 14.4 pounds and contains a charge of 1.4 pounds of TNT. It comes equipped with a point detonating, PD M48A2 or M51A4 fuze, either of which may be set for instantaneous (SQ) or delayed (DELAY) detonation (fig. 5).

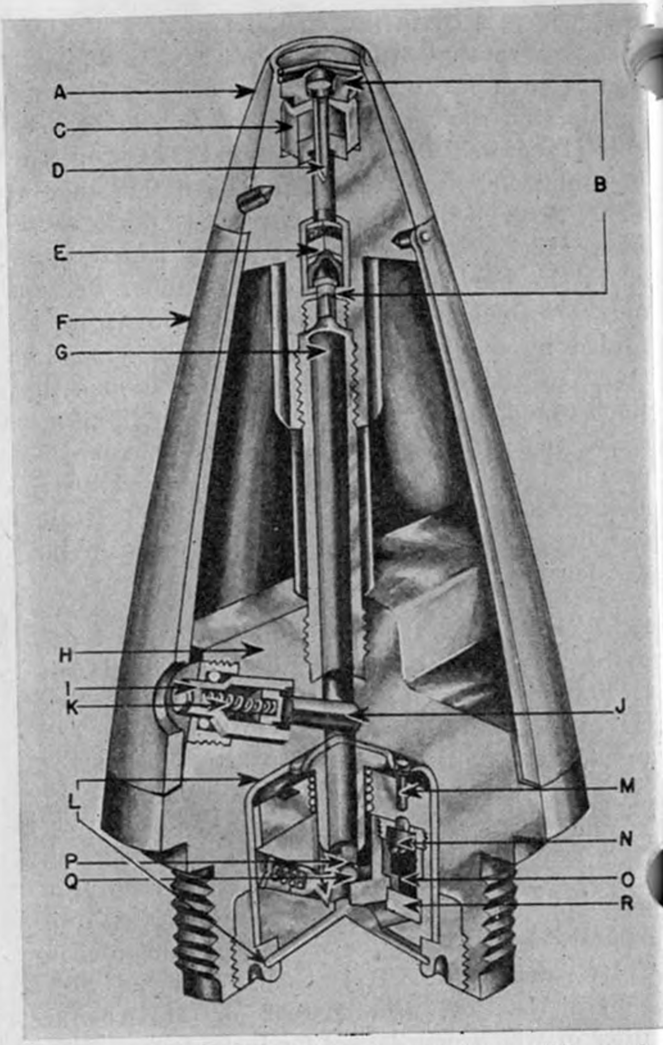

A
C
D
E
F
G
H
I
K
L
P
Q
B
J
M
N
O
R

Figure 5. Fuze PD M48A2 and M51A4 for HE round, 75-mm rifle, M20.

Note. The only difference between the two fuzes is the booster charge.

Settings are made by turning a setting screw in the side of the fuze. Setting positions marked "DELAY" and "SQ" (superquick) are stamped on the side of the fuze ogive (F). The setting device is an eccentrically positioned plunger (J) and plunger spring (K) the functioning of which is regulated by a setting sleeve (I). The head of the sleeve is slotted to facilitate turning when adjusting the setting.

b. When the slot in the sleeve head is alined with the "SQ" line, the sleeve, which is thicker on one side than on the other, is turned so that it does not interfere with movement of the plunger. The plunger is free, therefore, to move outward under centrifugal force, and thereby open the passage (G) from the head of the fuze to the booster charge. Superquick detonation occurs when the nose of the fuze strikes an object. The head of the fuze (A) is crushed and the firing pin (D), which is supported by a gilding metal cup (C), is driven into the detonator (E) setting it off. The flash from the detonator passes down the tube (G), which connects the superquick action (B) to the body (H), and into the booster.

c. When the slot in the setting sleeve is alined with the "DELAY" line the thick side of the sleeve is in position to stop any outward movement of the plunger, and even though the superquick action functions normally on impact, the detonator flash never gets past the plunger into the booster. On impact the delay action (L) comes into play. Centrifugal force causes the plunger pins (Q) to recede outward, thereby leaving th delay action mechanism free to move forward. Centrifugal force also causes the plunger pin lock (P) to place an arm against the inner end of each plunger pin so that the pins are prevented from returning to the unarmed position. On impact, inertia causes the delay action plunger to move forward driving the primer (N) against the firing pin (M). The primer ignites the black powder delay pellet (O) which in turn detonates the relay charge (R). No action takes place upon firing until sufficient rotational speed has been established to overcome the resistance of springs and set back force on the safety devices. Bore-safe superquick action is provided by the plunger (J). Bore-safe delay action is provided by the M20 booster for the M48A2 fuze, and by the M21A2 booster for the M51A4 fuze.

15. HIGH EXPLOSIVE ANTITANK. a. The armor penetrating ability of a normal projectile depends upon its weight, velocity at time of impact, and angle of impact. Since muzzle velocities have been greatly reduced in this weapon, it is necessary to employ a shaped or hollow charge in order to secure armor penetration. The HEAT projectile employs such a charge. The projectile weighs 13.1 pounds. The fuze for the projectile is the base detonating BD M62A1 (fig. 6) for which there is no setting of delay.

b. The firing pin (K) is held in the unarmed position in the percussion plunger by spring-held

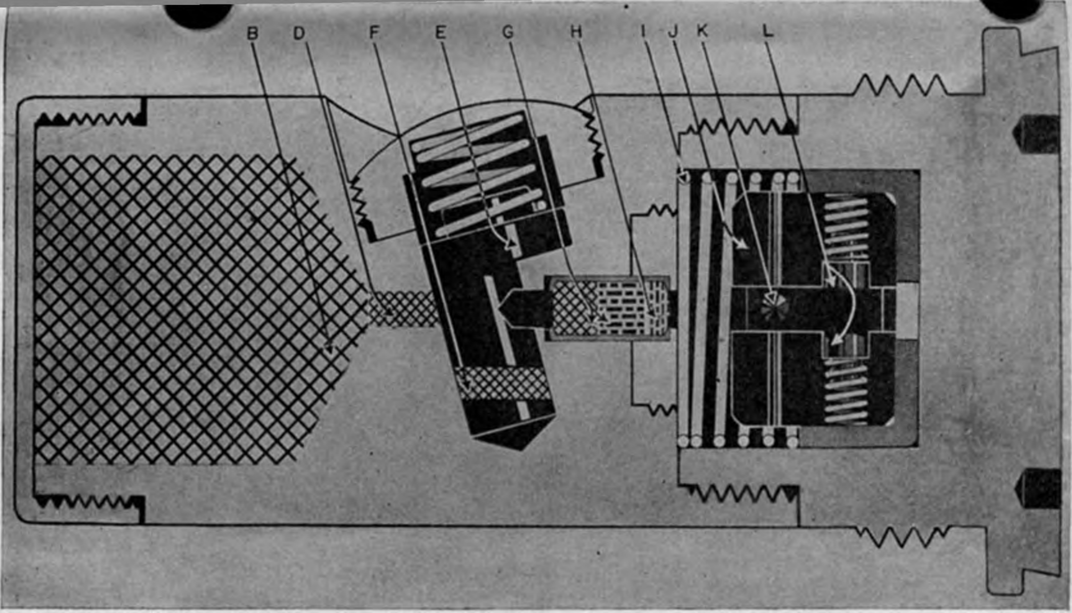

B
D
F
E
G
H
I
J
K
L

Figure 6. Fuze BD M62A1 for HEAT round, 75-mm rifle, M20.

safety pins (L) which release the firing pin under the action of centrifugal force. The percussio plunger assembly will not arm at 1,700 revolutions or less per minute. The slider assembly (E) is normally positioned under spring pressure in its recess in the fuze body so that the slider charge (F) of the slider is out of alinement with the other explosive elements. When sufficient centrifugal force has been set up, the slider overcomes the resistance of the spring and moves outward, bringing the slider charge (F) into alinement. The slider will not arm at 2,400 revolutions or less per minute, but must arm at 3,600 revolutions per minute. Upon firing, and after sufficient rotational force has been created, the firing pin and slider move into the armed position. However the percussion plunger assembly (J) is held to the rear during the flight of the projectile by the restraining spring (I). Upon impact, the plunger overcomes the resistance of the springs and carries the firing pin forward against the primer (H), initiating the action of the explosive train (G) through the booster lead (D). The booster pellet (B) in its turn causes detonation of the shell bursting charge.

16. **SMOKE.** The smoke, WP, projectile (weig 15.1 pounds) is used for screening smoke, incendiary action, limited antipersonnel action, spotting round, or any combination of these. The filler is white phosphorus. The projectile has a thin wall tubular casing, called the burster, which extends nearly the length of the filler cavity, and which

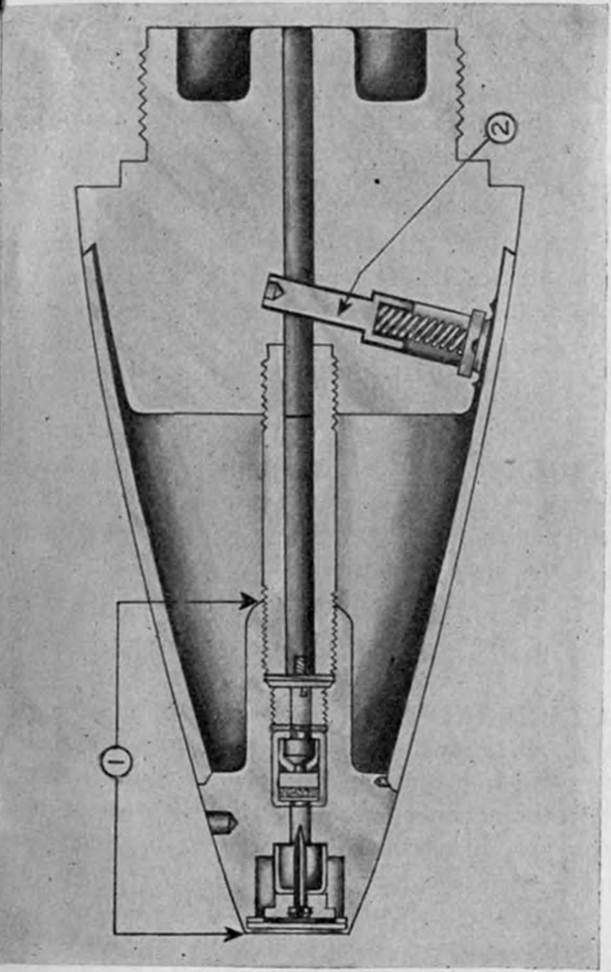


Figure 7. Fuse M57 for WP round, 75-mm rifle, M20.

contains a detonator relay chain and a burster charge of high explosive to rupture the shell and disperse the chemical contents. The fuze M57 (fig. 7) is essentially the M48A2 fuze modified to a single action superquick type by omitting the delay element, and is of the same size, shape, and weight. There is no setting sleeve on the centrifugal interrupter.

17. TARGET PRACTICE. The target practice projectile weighs 14.4 pounds. It is made of cast iron and has the same dimensions, weight, and center of gravity as the HE projectile. It contains a black powder spotting charge and is equipped with the M51A4 fuze (fig. 5).

18. INERT. The inert projectile contains no explosive charge. It is plastic loaded to bring it up to the weight of the HE projectile (14.4 pounds). It is equipped with the dummy fuze M73.

Section V. CARE AND CLEANING

19. GENERAL CARE. Dirt and grit, accumulated in traveling or from blast of the piece in firing, form cutting compounds. Powder fouling settles between and on operating parts and attracts moisture, prevents proper operation of moving parts, and hastens the formation of rust. Dirt, grit, and powder fouling should be cleaned from all parts at frequent intervals, depending upon use and service. If rust should accumulate, its removal from bearing surfaces requires special care in order that clearances are not unduly increased. Crocus cloth should be used for this purpose. The use of coarse abrasives is strictly forbidden. When the weapons are not in use they should be properly oiled and covered.

20. PREVENTIVE MAINTENANCE SCHEDULES. a. Before firing. (1) Remove and disassemble the breechblock group and wipe all components thoroughly dry.

(2) Thoroughly clean the bore and chamber of all dirt and oil.

(3) Assemble the gun and wipe outer surfaces with a clean, dry rag.

b. After firing. The procedures outlined below are to be followed immediately after firing and are to be repeated each day for three consecutive days, or until there is no longer evidence of sweating. The materials and the cleaning and preserving procedures to be used for recoilless weapons' bores are indicated in order of preference below.

(1) *Rifle bore cleaner.* (*a*) Thoroughly clean the bore with rifle bore cleaner each day for two days after firing, making sure that all surfaces are well coated. Do not wipe dry.

(*b*) On the third day after firing, clean the bore with rifle bore cleaner. If the piece is to be fired within the next 24 hours, do not wipe dry until just before firing. If the piece will not be fired within the next 24 hours, wipe dry and coat with the prescribed oil.

Note. The bore should not be cleaned with bore cleaner until the tube has cooled to the point where it can be touched with the bare hand. Bore cleaner is an excellent rust preventive for periods of from 24 to 48 hours.

(*c*) Following the third day after firing, renew the oil film daily. Every fifth day, clean with rifle bore cleaner, wipe dry and oil.

(2) *Soda ash.* (*a*) Prepare a solution of ½ pound soda ash to each gallon of warm water. In temperatures below 32° F., and if the tube to be cleaned is cold, add the type and amount of antifreeze prescribed in TM 9–850.

(*b*) Immediately after firing and on three consecutive days thereafter, thoroughly clean the bore with the soda ash solution. Rinse with clear warm water and wipe dry. Coat with the prescribed oil.

(*c*) When the piece is not being fired, renew the oil film daily. Every fifth day clean the bore with dry cleaning solvent, wipe dry, and oil.

(3) *Soap.* (*a*) Use castile or issue soap. Prepare a sponging solution by shaving 1 pound of soap into 4 gallons of water. If possible, warm the water to facilitate dissolving the soap. In temperatures below 32° F., and if the tube to be cleaned is cold, add the type and amount of antifreeze prescribed in TM 9–850.

(*b*) Follow the same cleaning, drying, and oiling procedure prescribed for soda ash solution.

Caution: When issue soap is used, the bore must be thoroughly rinsed after cleaning as the soap may contain a free caustic which will cause corrosion if not completely removed.

(4) *Hot water.* (*a*) As a temporary measure after firing, the bore may be cleaned while still hot by swabbing with quantities of hot water. This method will be used only when rifle bore cleaner, soda ash, or soap is not available. After cleaning with hot water extreme care must be taken to dry the bore thoroughly. A coating of oil will be applied immediately thereafter to prevent rust.

(*b*) Swabbing with hot water may not remove all of the primer salts or powder residue. It is most important, therefore, that the bore be cleaned as soon as possible in accordance with (1), (2), or (3) above.

c. Chamber. The method and materials used for cleaning the bore will be used for cleaning the chamber. However, the bore brush is impractical for cleaning the chamber and an improvised burlap swab on a stick should be used.

d. Breech. The breech mechanism must be disassembled, all parts cleaned and oiled, and reassembled at each cleaning. Rifle bore cleaner, preferably, or commercial dry cleaning solvent may be used to clean the parts.

e. Oiling. For temperatures above 0° F., oil, lubricating, preservative, *medium,* should be used for oiling all parts; for temperatures below 0° F., oil, lubricating, preservative, *special,* should be used. See War Department Lubrication Order 9–304, Rifle, 57-mm, M18.

f. Care in the field and during combat. The same procedures for care and cleaning should be followed in the field and during combat as are prescribed above where the materials and the time are available. Shortage of prescribed materials will have to be dealt with by substitute measures. Where none of the materials listed above are available, swabbing the bore with dampened rags followed by thorough drying and swabbing with oily rags will serve as an emergency measure. It must be remembered that this treatment is a temporary measure only, and that at the first opportunity the weapon should be cared for as described in **a** through **e** above.. In the event lubricants prescribed in **e** above are not available the lubricants listed below may be used as emergency substitutes:

Preservative lubricating oil (light).

Lubricating oil for aircraft instruments and machine guns.

Engine oil, SAE 10 (above 32° F.).

g. Operation under unusual conditions. The procedures for the mechanical operation of the rifle are the same for operation under either usual or unusual climatic conditions. In addition to the normal preventive maintenance service specified throughout this manual, special care in cleaning and lubrication should be observed where extremes of temperatures, humidity, and atmospheric conditions are present. Proper cleaning and lubrication not only insure proper operation and functioning but also guard against excessive wear of the working parts and deterioration of the matériel.

(1) *Cleaning in cold climates.* (*a*) In temperatures below freezing, it is necessary that the working parts of the rifle be kept absolutely free from mois-

ture. Take special care to remove excessive oil on the working parts because it will congeal to such an extent as to cause sluggish operation and functioning, or complete failure. This applies, in particular, to the small spring-operated parts in the breech mechanism and trigger group.

(*b*) Protect rifles not in use with the proper covers to prevent frosting.

(*c*) Allow rifles taken into heated buildings to come to the temperature of the building before cleaning. Immediately after they reach room temperature, disassemble to the extent outlined in paragraph 5. Thoroughly wipe all moisture from all parts as well as the bore and chamber to prevent rusting. Then thoroughly clean by one of the methods outlined above and lubricate as outlined.

(2) *Cleaning in hot climates.* (*a*) In hot climates, the thin film of oil necessary for operation and preservation will be quickly dissipated. Inspect rifles frequently, paying particular attention to unexposed surfaces such as the bore and chamber, springs and spring seats, firing pin, and like places where corrosion might occur and not be quickly noticed. When necessary renew a film of the oil prescribed above. Keep screws and pins lightly oiled to prevent rust from attacking them and "freezing" them in place.

(*b*) Protect rifles not in use with the proper covers.

(*c*) Perspiration from the hands is a contributing factor to rusting because it contains acid. After handling, wipe dry and restore the oil film.

(3) *Cleaning under excessively sandy or dusty conditions.* (*a*) In localities where dust and sand storms are prevalent, carefully protect the rifles with proper covers. Dust and sand will enter the mechanism and bore and stick on lubricated surfaces, forming a gummy paste which may clog the rifle and cause malfunction. This paste will also act as an abrasive and will cause undue wear of the moving parts of the rifle.

(*b*) Under such conditions thoroughly clean and lubricate the rifles as often as necessary.

(*c*) Disassemble to the extent outlined in paragraph 5. Clean by one of the methods outlined above. Lubricate with the oil specified. Apply the oil to moving parts and contacting surfaces only. The film of oil will be as light as possible for proper functioning of the rifle.

(4) *Cleaning in excessively moist or salty atmosphere.* Salt air is conducive to quick rusting as the salt has a tendency to destroy the rust-preventive qualities of the oil. When operating the rifle under these conditions, treat it in a manner similar to that prescribed for operation in hot climates.

h. Demolition to prevent enemy use. (1) The destruction of the matériel, when subject to capture or abandonment in the combat zone, will be undertaken by the using arm only on authority delegated by the division or higher commander, as a command function, when such action is deemed necessary as a final resort to keep the matériel from reaching enemy hands. The barrel assembly and breech mechanism are the most vital parts of this rifle. Next in importance are the mount and gun book. Adequate destruction of this matériel means damaging it in such a way that the enemy cannot restore it to usable condition in the combat zone by repair or cannibalization. Adequate destruction requires that—

(*a*) Enough parts essential to the operation of the matériel must be damaged.

(*b*) Parts must be damaged beyond repair in the combat zone.

(*c*) The same parts must be destroyed on all matériel, so that the enemy cannot make up one operating unit by assembling parts from several partly destroyed units.

(2) To demolish the rifle proceed as follows:

(*a*) Detach all optical sights. If evacuation is possible, carry the sights; if evacuation is not possible, thoroughly smash the sights.

(*b*) Depress muzzle. Open breech. Using incendiary grenade M14, pull safety pin, but continue to hold the grenade safety handle in safe position. Aline grenade with open breech. Release safety handle and insert grenade into the chamber. Stand clear to the side at least 15 yards. The intense heat of the burning incendiary grenade will damage the chamber and molten iron will pour through the bore and render it unserviceable.

Caution: Be sure to use an incendiary grenade and *Not* a fragmentation or offensive grenade.

(*c*) For information on demolition of ammunition, refer to TM 9–1901. For information on demolition of mounts and fire control equipment refer to FM 23–55.

Section VI. MOUNTINGS

21. TRIPOD M1917A1. The 75-mm rifle, M20, was designed to be mounted on the Browning machine gun tripod M1917A1 (for description see FM 23–55). Two mounting brackets are assembled on the piece. The rear mounting bracket is at the junction of the tube and chamber. The front mounting bracket is a circular removable bracket which is clamped and tightened on the tube by means of screws. The position of the front mounting bracket can be adjusted to fit the mounting brackets of the gun to the tripod. The gun pintle is attached to the rear mounting bracket, and the front mounting bracket fits over the elevating screw head. The gun is mounted on the tripod with the trail leg and longer arm of the cradle to the front (fig. 1).

22. OTHER MOUNTINGS. Although the rifle is normally to be mounted on standard ordnance mounts, it may be mounted on any mount that will take a pintle. Successful and efficient firing has been accomplished with the gun mounted on the light machine gun tripod M2 (fig. 8), and on the pedestal and dashboard mounts of the ¼-ton truck (fig. 9). When firing from the ¼-ton truck, care must be taken that the back blast does not damage any part of the vehicle. The use of improvised mounts can be dangerous; hence the need for sufficient clearance and safety precautions must be emphasized.

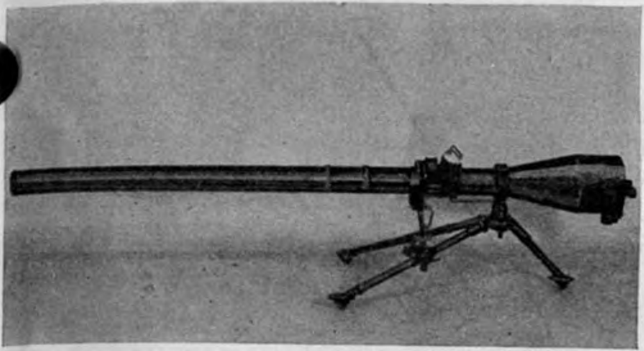


Figure 8. 75-mm rifle, M20, mounted on light machine gun tripod.

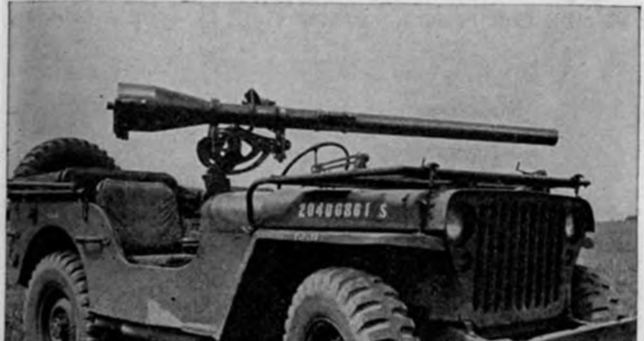


Figure 9. 75-mm rifle, M20, mounted on ¼-ton truck, dashboard mount.

Section VII. FIRE CONTROL INSTRUMENTS

23. GENERAL. Since the 75-mm rifle M20 is capable of delivering both direct and indirect fire, it is equipped with two sights. The telescopic sight M85C is used for direct fire for ranges up to and including 2,100 yards. The telescopic sight M34 is used for direct fire for ranges over 2,100 yards and for all indirect fire.

24. SIGHT M85C. The sight M85C (fig. 10) is a short tube telescope provided with a sunshade and rubber eyeshield. The telescope is a fixed focus, three-power instrument having a field of view of 11° 30′. The reticle pattern (fig. 11) consists of a

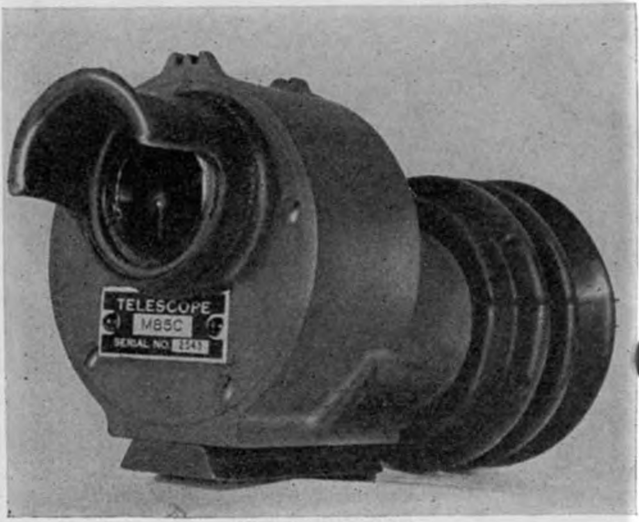


Figure 10. Sight M85C for 75-mm rifle, M20.

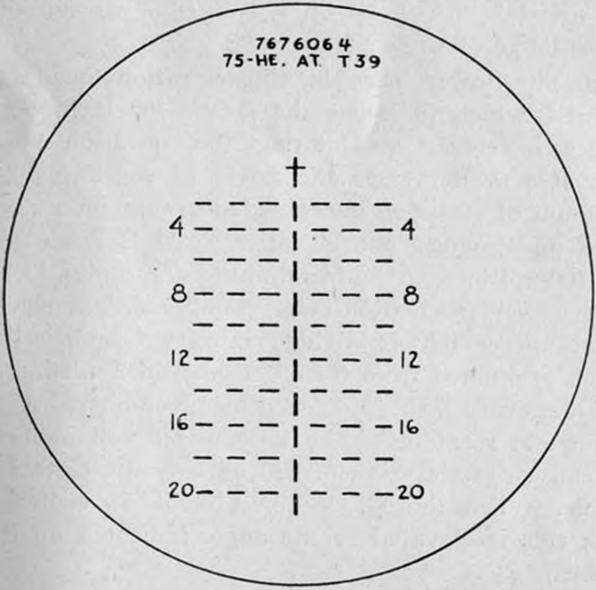


Figure 11. Sight reticle, sight M85C.

series of broken horizontal lines and a broken vertical line. The cross hair at the top of the pattern represents zero deflection and zero elevation. Each vertical line segment and each space between the segments represents a change in range of 100 yards. Each horizontal line segment and each space between the segments represents an angular lead of 5 mils. There is a dovetail slot, with a window, on the side of the telescope. To this may be fixed the night lighting device. The open sight which has been built on top of the telescope is used for quick alinement of the sight on the target.

25. SIGHT M34. The sight M34 (fig. 12) consists essentially of three parts.

a. The lower part is the elevation quadrant T13E1 which furnishes the means for laying the piece in elevation. Rotating the elevation knob elevates or depresses the angle of sighting. The amount of elevation is registered in mils on a scale and micrometer. The elevation scale is graduated in 100-mil increments from minus 200 to plus 1,600, every even graduation being numbered. The elevation micrometer is divided into two semicircles, each graduated from 0 to 100 mils, in 2-mil increments, every fifth graduation being numbered. One complete rotation of the micrometer will indicate a change in elevation of 200 mils on the elevation scale. When the longitudinal bubble is centered, the rifle is elevated to the angle indicated on the scale.

b. The telescope adapter M9 is the center part of the sight. It contains the mechanism and scales for laying the piece in direction. It has an azimuth scale which is graduated in 100-mil increments in two semicircles from 0 to 3,200 mils each. Every fourth graduation is numbered. The deflection micrometer is graduated from 0 to 100 mils in 1-mil increments, each tenth graduation being numbered. Azimuth or deflection is set on the scale and micrometer by turning the azimuth worm knob. For rapid motion in azimuth, the internal worm and worm gear can be disengaged by pushing outward on the azimuth worm knob. The adapter also contains the cross level bubble. An open sight has been built as an integral part of

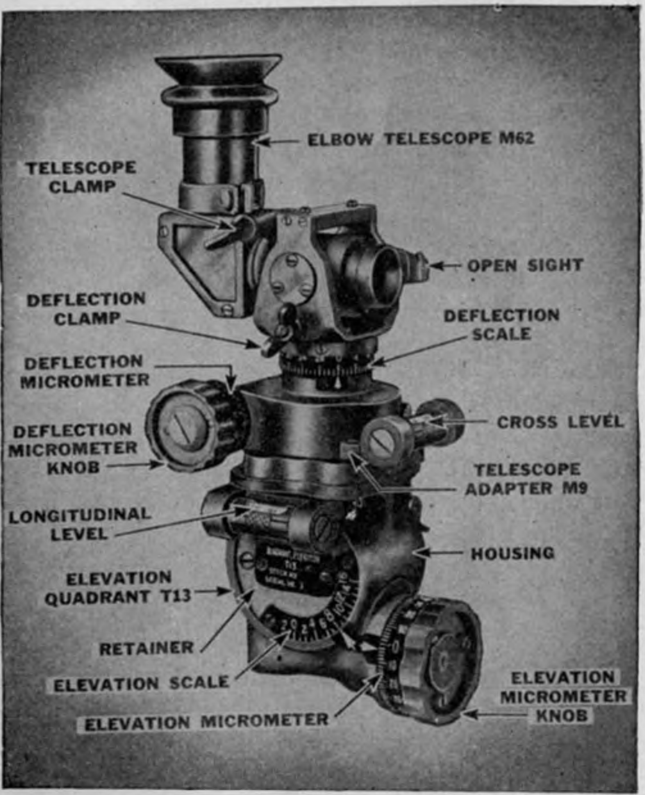

ELBOW TELESCOPE M62
TELESCOPE CLAMP
OPEN SIGHT
DEFLECTION CLAMP
DEFLECTION SCALE
DEFLECTION MICROMETER
CROSS LEVEL
DEFLECTION MICROMETER KNOB
TELESCOPE ADAPTER M9
LONGITUDINAL LEVEL
HOUSING
ELEVATION QUADRANT T13
RETAINER
ELEVATION SCALE
ELEVATION MICROMETER KNOB
ELEVATION MICROMETER

Figure 12. M34 for 75-mm rifle, M20.

the adapter and is used for quick alinement of the sight on the target or aiming point.

c. The top part of the sight is the elbow telescope M62, which is a three-power, fixed focus instrument having a field of view of 12° 12′. The reticle pattern consists of a vertical and a horizontal line which cross at the reticle center. The telescope is attached to the adapter in such a manner that, by loosening the elevation clamping screw, the telescope can be elevated or depressed independently of the elevating mechanism; and by loosening the telescope clamping screw, the telescope can be rotated about the axis of the horizontal arm of the scope. A dovetail bracket housing a window, on the side of the telescope, is provided for attaching the night lighting device.

26. LENSATIC COMPASS. The lensatic compass is standard for fire control use with the 75-mm rifle, M20. The prismatic compass may be used but the watch compass is unsuitable for such use. For description and operation of the lensatic compass, see FM 23–90.

27. BINOCULAR. For nomenclature, operation, and maintenance, see TM 9–575.

28. PLOTTING BOARD M10. a. General. Complete data on description and operation of the M10 plotting board can be found in FM 23–55.

b. Use. The M10 plotting board is used by personnel of the 75-mm rifle platoon to facilitate figuring of initial fire data for the 75-mm rifle, M20, as follows:

(1) When the ranges involved are greater than can be accommodated on the board by use of the half value scale, any point on the disc may be used as the OP. In such cases, ranges for plotting OT and OG are measured parallel to the index line with the disc set for the required azimuth.

Data for GT are then obtained as usual. The ange scale may be doubled or quadrupled, thus permitting use of the plotting board for longer ranges without selecting a different point to be used as the OP.

(2) To find fire data from a gridded map, obtain from the map the coordinates of the OP, the gun position, and the target. On the plotting board, with the disc set at zero, and using the grid system of the plotting board with any convenient grid intersection as a common point of origin, plot coordinates as read from the map on the disc. Azimuth and range are then read as above. Azimuths obtained will be grid azimuths, subject to the usual correction for conversion to magnetic azimuths.

(3) When ungridded maps or aerial photos only are available, with north and either yard scale or representative fraction indicated, proceed as follows: On map or photograph at a convenient position draw in north-south and east-west lines, their intersection to serve as point of origin for coordinates. Coordinates of a point are obtained by measuring its lateral offset from the north-south line, and its vertical offset from the east-west line. If a graphic yard scale is available, it is used for measuring. Resulting coordinates are applied directly to the grid system of the plotting board, as above, and resulting ranges read in yards thereon. If no graphic scale is available but the representative fraction is known, measurements are made on the map or photo in inches and applied to plotting board grid system accordingly. Result-

ing azimuths will be correct, but resulting range will be in the scale of the plotting boar $\left(1'' \text{ to } 1000 \text{ yards or } \frac{1}{36000}\right)$ and must be converte to scale of the map or aerial photo by applying th ratio between the denominator of indicated representative fraction and that of the plotting board. Thus, if range on the plotting board is 1500 yard (1.5″), and representative fraction of the phot or map is $\frac{1}{24000}$, actual range is $\frac{24000}{36000} \times 1500$, or 1000 yards.

29. GUNNER'S QUADRANT M1 (fig. 13).

a. General. The gunner's quadrant M1 is used i laying for elevation and for leveling the gun durin tests and adjustments.

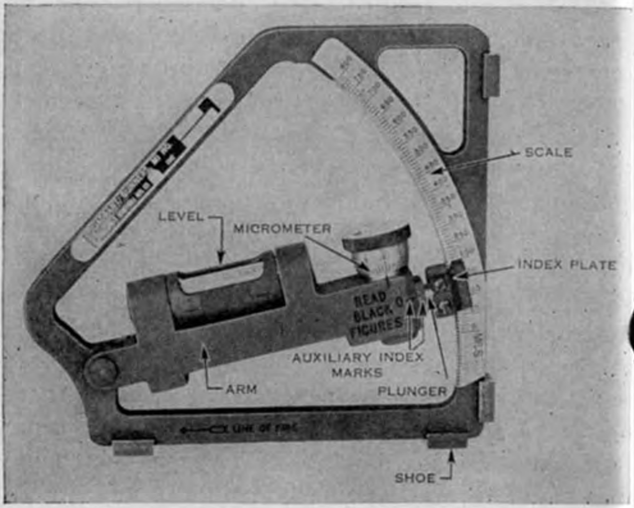

SCALE
LEVEL
MICROMETER
INDEX PLATE
READ BLACK FIGURES
AUXILIARY INDEX MARKS
ARM
PLUNGER
LINE OF FIRE
SHOE

Figure 13. Gunner's quadrant M1.

b. Description. This quadrant includes a sector shaped frame to which is pivoted an arm carrying a level. Notches on the frame engaging with a plunger in the arm permit rapid setting of the arm to elevations from 0 to 800 mils. Separate scale and micrometer indications on opposite sides of the quadrant are used to obtain elevation readings.

c. Operation. (1) To lay the piece at a given elevation, set the scale and micrometer at the required angle and place the corresponding reference surface on the quadrant seat of the gun. Elevate the gun slightly above the center position of the leveling bubble, then depress it until the bubble is centered.

(2) To measure the elevation of the gun, place the proper reference surfaces of the quadrant on the leveling plates, parallel to the bore, with the associated arrow pointing in the direction of fire. (Black arrow and black figures are for readings from zero to 800 mils; red arrows and red figures are for readings from 800 to 1,600 mils.) Set the micrometer at zero. Disengage the plunger from the notches in the frame, lift the arm, and lower it slowly until the bubble is seen to pass through the central point of the level. Allow the plunger to engage with the notches and turn the micrometer until the bubble is accurately centered. Face the side of the quadrant which bears the arrow in use, and read the scale and micrometer indications. A note engraved below the micrometer indicates whether the red or black micrometer figures are to be read. The scale is divided into 10-mil

graduations. The micrometer is divided into 1-mil graduations up to 10. The elevation of the gu in mils is equal to the sum of the scale and micrometer readings. Remove the quadrant from the gun before firing.

(3) To measure depression angles, proceed as above, but with the line of fire arrow pointed in the reverse direction.

d. Test and adjustment. No adjustment of the quadrant by the using arm is permitted. The zero position may be verified (end-for-end) by setting the scale and micrometer at zero elevation, elevating or depressing the gun to center the bubble, then turning the quadrant end-for-end. If the bubble does not remain centered, rotate the micrometer until it is centered. Note the reading on the micrometer. Apply one half of the reading to the micrometer and re-level the tube. This reading may be used as zero.

30. AIMING CIRCLE M1. For complete description of this instrument see FM 23–90.

31. CARE AND PRESERVATION. a. General. (1) Fire control and sighting instruments will not stand rough handling or abuse; inaccuracy or malfunctioning results from such mistreatment.

(2) Instruments are kept as dry as possible they are not put in their carrying cases when wet

(3) When not in use, instruments are kept in carrying cases provided or in the condition indicated for traveling.

(4) Any instruments which give incorrect read

ings and/or fail to function properly after the authorized tests and adjustments have been made are turned in for repair by ordnance personnel. Only those adjustments expressly authorized are performed by using personnel. The turning of screws or other parts not essential to the use of the instrument is expressly forbidden.

(5) No painting of fire control equipment by using personnel is permitted.

(6) Many worm drives have "throwout" mechanisms to permit rapid motion through large angles. When using these mechanisms, the throwout lever must be fully depressed to prevent injury to the worm and gear teeth.

(7) When using a tripod with adjustable legs, the legs must be clamped tightly to prevent the possibility of collapse.

(8) When setting up tripods on sloping terrain, two legs are placed on the downhill side to provide maximum stability.

(9) Exposed moving parts should be oiled occasionally with a small quantity of neutral oil. Interior parts are oiled by ordnance personnel. Any excess lubricant that seeps from the mechanisms is wiped off to prevent accumulation of dust and grit.

(10) Optical instruments must not be pointed directly at the sun.

(11) Compass needles and dials must always be clamped in position when not in use.

(12) Forced rotation of any of the knobs beyond their limits must be avoided.

(13) The clamps on the aiming circle legs must be turned outward to prevent damage to the vertical support of the aiming circle when legs are folded.

b. Optical parts. (1) To obtain satisfactory vision, the exposed surfaces of the lenses and other parts should be kept clean and dry. Corrosion and etching on glass surfaces, which greatly interfere with the good optical qualities of the instrument, can be prevented or minimized by keeping the glass clean and dry.

(2) Under no condition will polishing liquids, pastes, or abrasives be used for polishing lenses and windows.

(3) To remove dust, the glass is brushed lightly with a clean camel's-hair brush; the brush is then rapped against a hard surface to knock out the small particles of dust that cling to the hairs. This operation is repeated until all dust is removed. With some instruments an additional brush with coarse bristles is provided for cleaning mechanical parts. Each brush is used only for the purpose intended.

(4) Particular care will be exercised to keep optical parts free from oil and grease. Lenses or windows are not wiped with the fingers. To remove oil or grease from optical surfaces, ethyl alcohol is applied with a clean camel's-hair brush; afterward the surfaces are rubbed gently with clean lens paper. If alcohol is not available, breathe heavily on the glass and wipe with a clean lens paper. This operation is repeated several times until the lens is clean.

(5) When the temperature of the parts is lower han that of the surrounding air, moisture may ollect on the optical parts of the instrument. This moisture, if not excessive, can be removed by placing the instrument in a warm place. Heat from strongly concentrated sources should not be applied directly, as it may cause unequal expansion of parts, thereby resulting in breakage or distortion of optical parts, and causing inaccuracies in observation.

Section VIII. EQUIPMENT, SPARE PARTS, AND ACCESSORIES

32. EQUIPMENT, SUBCALIBER. a. General. Subcaliber equipment component parts are—

(1) Subcaliber device, 75-mm, complete.

(2) Firing pin, subcaliber, 75-mm.

(3) Firing pin bushing, 75-mm.

b. Description. The subcailber device (figs. 14 and 15) consists of a 75-mm drill cartridge T8 or 75-mm inert cartridge T38 with fuse, primer, and igniter removed. In the base of the cartridge case is mounted the barrel bushing. The projectile is drilled through the center of the base to receive carbine barrel and barrel extension tube (essenially a pipe threaded at both ends). Over the forward portion of the barrel extension tube is fitted the head space adjustment nose, which is held in place by the barrel locking nut. The subcaliber firing pin is the same as a normal firing pin except that the striker has been turned down from 3/16"

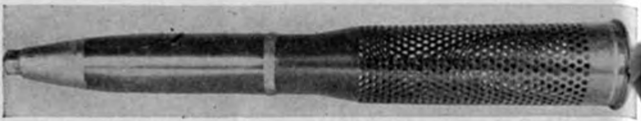


Figure 14. Subcaliber device assembled.

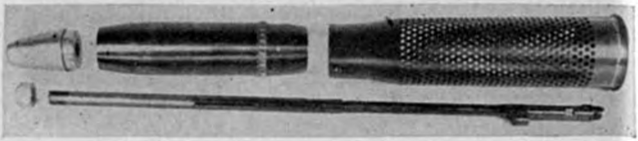


Figure 15. Subcaliber device disassembled.

to $\frac{1}{16}''$. The firing pin bushing fits in the firing pin aperture and over the firing pin.

c. Installation. Remove firing pin from hammer and replace with subcaliber firing pin (fig. 16). Remove extractor. Assemble the rifle. Open the breech and insert firing pin bushing in firing pin aperture. Insert the subcaliber device into the breech, match the preengraved rotating band, and fully seat. The device is positioned in the tube by the preengraved rotating band and neck of the cartridge casing. To remove the subcaliber device, unload in the same manner as service ammunition.

d. Operation. Loading, firing and extraction: Carbine cartridges are loaded by hand into the breech of the subcaliber device. Care must be taken in closing the breech since the extractor has been removed. This allows rotation of the breechblock on the hinge while in the open position. Undue roughness and carelessness will result

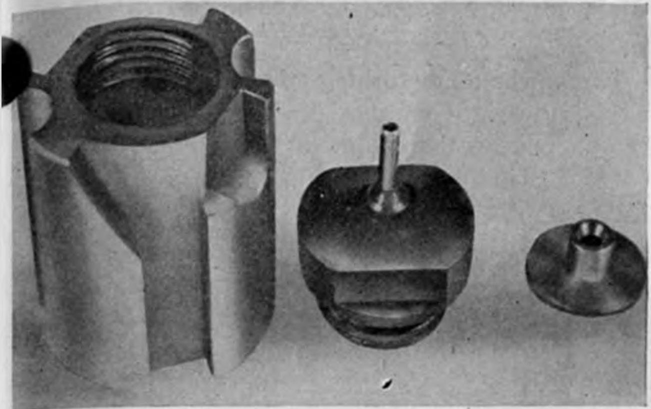


Figure 16. Hammer, subcaliber firing pin, and bushing.

in burring and jamming of locking surfaces. After the breech is closed the trigger is actuated; this causes the firing pin to move forward, guided by the firing pin bushing, and strike the primer of the carbine cartridge. As the propellant gases leave the muzzle of the carbine barrel they tend to "burble" ahead of the projectile causing inaccuracy. The gas escape slots allow these propellant gases to escape sidewise, thereby allowing the projectile to travel accurately.

e. Extraction. Extraction of the carbine cartridge should be accomplished by use of a screw driver. This method requires approximately the same amount of time for extraction as that necessary for a service round thereby simulating service firing.

f. Targeting. The rifle will be targeted prior to range firing. This is accomplished as follows:

(1) Fire five rounds at 1000 inches to obtain a group.

(2) Without disturbing the lay of the piece adjust the sight so that the desired sight picture is obtained on the center of the group.

(3) Check the sight setting by firing five more rounds.

(4) After targeting has been completed, do not remove the device from the chamber until completion of firing, unless necessary for headspace adjustment.

g. Head space adjustment. Head space must be properly adjusted prior to and during all firing. To adjust:

(1) Loosen barrel locking nut.

(2) Turn the head space adjustment nose, screwing the barrel in the barrel bushing until the projection on the breech is flush with the base of the 75-mm cartridge casing.

(3) During firing, head space will change due to induced torque; therefore it must be checked continuously.

(4) Caution must be observed to keep the breech operating handle assembly screws tight, or loose head space will occur.

(5) Ruptured cartridges should be removed only by a carbine ruptured cartridge extractor. If the breech is difficult to close, tight head space may exist and cause rupturing of cartridges.

h. Care and cleaning. The device should be cleaned after each firing and three days thereafter.

The unit should be disassembled for cleaning. For details of care and cleaning see paragraphs 19 nd 20.

33. ADDITIONAL EQUIPMENT. For information on other equipment, spare parts, and artillery gun book, see TM 9–314 and ORD 7, ORD 8, and ORD 9, respectively, SNL C74.

CHAPTER 3

TRAINING FOR PLACING GUN

Section I. CREW DRILL

34. GENERAL. a. The object of crew drill is t give the section complete confidence in its abilit as a team to put its gun into action with precisio and speed.

b. The attainment of precision is the first ste in developing an expert section. This is achieve only by strict adherence to prescribed trainin procedure. After the desired degree of proficienc in precision has been attained, the next phases— teamwork and speed—are undertaken.

c. Teamwork is assured by rotation of dutie during drill so that each section member, by practice, becomes expertly acquainted with the dutie of every other member, particularly with the mor detailed actions of Nos. 1, 2, and 4. Continuity o action is made certain by this phase of training.

d. Practice for speed is instituted as the las phase of instruction in crew drill. Care must b taken during this phase to insure that precisio and teamwork are not sacrificed for speed.

35. ORGANIZATION AND EQUIPMENT FOR REW DRILL (fig. 17). **a.** Normally, the section will use only one of its two organic weapons for crew drill. The section leader is armed with an M1 rifle and carries binoculars, compass, gunner's quadrant, firing tables, and the sights.

b. No. 1 is the gunner. He is armed with a pistol and carries the tripod and cradle.

c. No. 2 is the loader. He is armed with a pistol and assists in carrying the tube. He wears a light pack and carries one thermite grenade.

d. No. 3 is a gunner's assistant. He is armed with a pistol and assists in carrying the tube. He wears a light pack and carries one thermite grenade.

e. No. 4 is a gunner's assistant. He is armed with a pistol and assists in carrying the tube. He wears a light pack and carries one thermite grenade.

f. No. 5 is an ammunition bearer. He is armed with a carbine and assists in carrying the tube up to the gun position whence he reverts to carrying ammunition. He wears a light pack and carries one thermite grenade.

g. Nos. 6, 7, and 8 are ammunition bearers. hey are armed with the carbine and carry pack boards with two rounds of ammunition. No. 8, in addition, carries the rammer staff and waste for swabbing out the bore. They each carry two fragmentation grenades.

h. No. 9 is the vehicle driver (¾-ton truck with 1-ton trailer). He is armed with an M1 rifle.

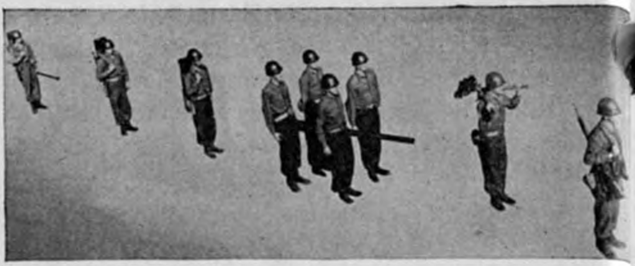


Figure 17. 75-mm rifle section with equipment.

36. DUTIES OF SECTION MEMBERS. a. Section leader (observer). The section leader is i direct command of the gun and its equipment including the vehicle. He conducts the section i accordance with the orders and instructions o his platoon leader or of the commander of th unit to which he is attached according to th dictates of the terrain and the situation. He is responsible for the care and maintenance of th gun and its equipment. In combat he is responsibl for the accomplishment of the section mission He controls and conducts the fire of the gun an is responsible for its proper concealment. He keep the platoon leader informed of the status of ammunition supply and maintains ammunition suppl by timely orders to the ammunition bearers.

b. No. 1 (gunner.) No. 1 lays and fires the gu and acts as section leader in the latter's absence He is careful to coordinate his actions with No. 2

c. No. 2 (loader). No. 2 is responsible for complying with the fire commands insofar as the loading of the gun with the proper type of ammunitio is concerned. He coordinates his movements an duties at the gun with No. 1. In the event both uns of the section are manned, he is the gunner of the second gun.

d. No. 3 (gunner's assistant). No. 3 takes up a position to the left of the gun for close-in defense. When the situation requires, he may carry ammunition from the vehicle to the gun. If both guns are manned, he is the loader of the first gun.

e. No. 4 (gunner's assistant). No. 4 directs the ammunition bearers in the placement of their ammunition. It is his duty to select the proper type of ammunition, prepare it for firing and hand it to No. 2. If both guns are manned, he is the loader of the second gun.

f. Nos. 5, 6, 7, and 8 (ammunition bearers). At the direction of the section leader, Nos. 5, 6, 7, and 8 carry ammunition from the vehicle or section dump to the gun. Otherwise, they take up positions in defense of the gun — No. 5 to the left, and Nos. 6, 7, and 8 to the right.

g. No. 9 (vehicle driver). No. 9 is responsible for driver maintenance of his vehicle and for its concealment and camouflage when halted.

37. SUPPLEMENTARY GUN AND AMMUNITION CARRIES. a. Using light machine gun tripod. Although the light machine gun tripod is not normally part of the section equipment, it still may be used as a mount from which to fire the gun. When it is so used it may be left attached to the gun for carrying, or No. 1 may be required to carry it. In either case, No. 1 can carry two rounds of ammunition.

b. Two-man carry. Two men can carry the tube for short distances. The carry is facilitated by attaching two long wooden rods parallel to the tube in such a manner that the rods can be supported on the shoulders of the carriers. Nos. 2 and 3 initially carry the tube, and Nos. 4 and 5 form the relief team. In this method, two additional men are free to carry ammunition.

c. Three-man carry. By attaching a cross bar and/or by the use of slings, the gun may be carried for short distances employing three men. Nos. 2, 3, and 4 carry the tube, and No. 5 is a relief member. The cross bar is affixed to the breech end, and the carriers carry either by hand or by slings strapped over their shoulders. The third man carries the muzzle end in a sling which may be held in the hand or strapped over the shoulder. This method allows one more man to carry ammunition.

d. Emergency carry. With either the light or heavy machine gun tripods in use, Nos. 2, 3, 4, and 5 may carry two rounds of ammunition for short distances.

38. TO FORM THE SECTION. At the command FORM FOR CREW DRILL, the members of the section fall in at attention in a column of twos behind the section leader (fig. 18). To clarify their positions for crew drill the sergeant commands CALL OFF. Upon that command the section calls off from left to right and from front to rear; for example, the first man in the left file is No. 1, the first man in the right file is No. 2, the second man in the left file is No. 3, etc.

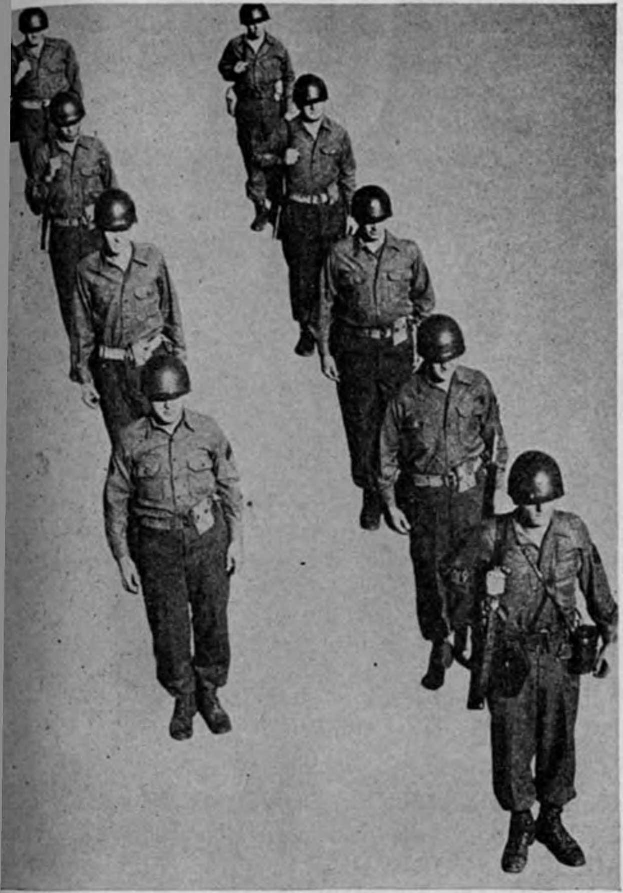


Figure 18. 75-mm rifle section at FORM FOR CREW DRILL.

39. TO POST THE SECTION. At the command POSTS, all section members move forward at double time to positions directly behind thei equipment which is laid out in order (fig. 19) on the drill ground.

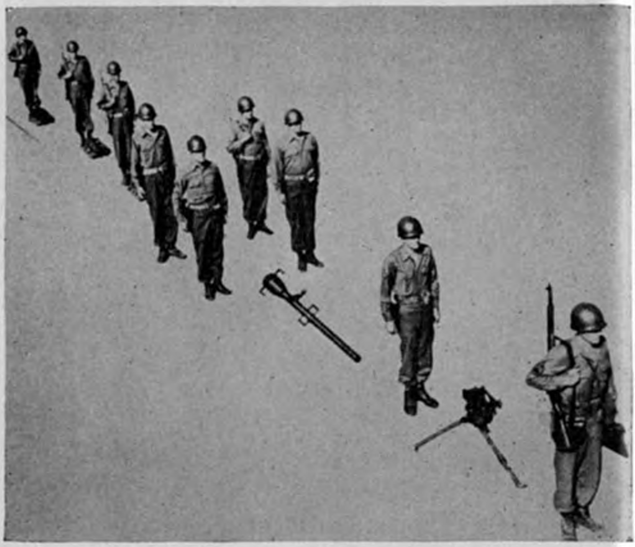


Figure 19. 75-mm rifle section at POSTS.

40. TO EXAMINE EQUIPMENT BEFORE DRILL. a. At the command EXAMINE EQUIPMENT BEFORE DRILL, given while the men are still at posts, individuals examine equipment in the following manner:

(1) *Section leader.* (*a*) Determines that he has the proper firing tables.

(*b*) Checks binoculars for broken parts and clean lenses.

(*c*) Checks gunner's quadrant for broken spirit level, lever arm and spring. Closes cover.

(*d*) Checks compass to see that it is not broken and that the needle is still on pivot.

(*e*) Checks sights.

(2) *No. 1.* (*a*) Checks traversing and elevating handwheels and centers them.

(*b*) Checks clamping and jamming handles.

(*c*) Checks dial clamp and zeroes the dial.

(3) *No. 2.* (*a*) Checks chamber and breech to determine that the chamber is clear and that the breech mechanism is in firing condition.

(*b*) Checks for Allen wrenches in breech handle.

(4) *Nos. 6, 7, and 8.* (*a*) Check to see that all ammunition is properly secured.

(*b*) Check to see that all straps are properly adjusted for carrying.

(*c*) Determine what type of ammunition is on hand and where it is carried.

(*d*) No. 8 checks cleaning materials and rammer staff.

(5) *No. 4.* Moves to the No. 6, 7, and 8 positions, checks type of ammunition being carried and its location on the various ammunition bearers.

b. When all equipment has been thoroughly and properly checked, the following commands are given from rear to front:

(1) No. 8 reports CORRECT.

(2) No. 7 reports CORRECT.

(3) No. 6 reports AMMUNITION CORRECT.

(4) No. 2 reports CORRECT.

(5) No. 1 reports GUN AND AMMUNITION CORRECT.

(6) The section leader reports ALL CORRECT.

41. TO SECURE EQUIPMENT. The section leader gives the command SECURE EQUIPMENT and faces in the direction of march. No. 1 picks up the tripod and cradle and places himself behind the section leader. No. 2 takes his position at the right tube handle. No. 3 takes his position at the left tube handle. No. 4 takes his position at the breech handle. No. 5 takes his position at the trigger handle. Nos. 2, 3, 4, and 5 lift the tube. Nos. 6, 7, and 8 sling ammunition and take their positions in column behind the gun. The section leader then signals and commands FOLLOW ME.

42. TO PLACE THE GUN IN ACTION. The section leader designates, by pointing, the direction of fire and the position upon which the gun is to be mounted, and commands ACTION. He then moves to the left front of the position designated for mounting the gun, where he can observe the target and control the firing of the gun. Moving to the left, No. 1 receives the sight from the section leader. As No. 1 moves to the left, Nos. 2, 3, 4, and 5 place the tube on the tripod; No. 5 lowers the pintle latch lever, depresses the trigger, and opens the breech; No. 2 removes the elevating pin from its carrying recess, and when the gun has been correctly positioned, he places it through the front mounting bracket; No. 3 stamps the left leg firmly into the ground; No. 2 stamps in the right leg; Nos. 3 and 5 move to the left front of the gun and take up security stations in defense of the gun. In the meantime No. 1 has placed the sight on the gun, locked it in place, and taken up his firing position on the left of the gun. No. 2 takes up his position at the gun where he can best service the piece. Sitting, kneeling on one or two knees, or squatting, are all satisfactory positions. In the kneeling position, the knee nearest the breech should be on the ground. No. 2 checks the bore for any obstructions, and reports CLEAR to indicate to the gunner that the bore is clear. Nos. 6, 7, and 8 bring up their pack loads of ammunition and place them in a semicircle as directed by No. 4. No. 8 places the rammer staff and waste near No. 4 where he can easily reach it. They then take up security stations to the right of the gun, No. 8 to the right front, No. 7 to the right oblique, and No. 6 to the right flank. No. 9 is the vehicle driver and will not normally leave his vehicle. The gun is now ready to fire. Upon receiving the fire command, all elements of which are repeated by No. 1, No. 4 draws the type of ammunition designated from its container and passes it to No. 2. No. 2 inserts it in the chamber, mates the preengraved rotating band with the lands and grooves in the tube, and seats the round firmly. He then closes the breech and taps the gunner's hand to indicate that the gun is ready to fire. No. 1 lays the gun on the designated target, takes the correct sight picture, places his hand above the chamber, and waits for the tap from No. 2 indicating that the gun is ready. On receipt of the tap he rotates the safety and depresses the trigger. After the round has been fired, No. 1 opens the breech. No. 2 grabs the base of the expended round with his left hand and throws it to the rear, away from the gun position.

43. TO TAKE THE GUN OUT OF ACTION. The section leader commands OUT OF ACTION. At this command No. 2 clears the gun, closes the breech, removes the elevating pin and replaces it in the carrying recess. No. 1 removes the sight and hands it to the section leader. Nos. 2, 3, 4, and 5 take their places beside the gun. No. 5 lifts the pintle latch lever. Nos. 2, 3, 4, and 5 pick up the tube and move to the rear. No. 1 swings the tripod to his shoulders. Nos. 6, 7, and 8 pick up their pack boards and fall in behind the tube. No. 8 also picks up the rammer staff and waste. The section is again ready to move out under the direction of the section leader.

44. TO CHANGE NUMBERS AND DUTIES DURING CREW DRILL. The section leader commands FALL OUT ONE, TWO, etc. At this command, No. 2 moves to the position of No. 1 and calls out ONE. Each succeeding number will move up one number and call out his new number. No. 1 moves to the position of No. 8. This rotation of duties should be continued until each member of the section is proficient in the duties of all eight members of the section. Caution must be observed at the command is not given during the time that the tube is being carried, since it is difficult to change over at that time.

Section II. BATTERY DRILL

45. GENERAL. a. The object of battery drill is to train the platoon to emplace guns in battery and to apply indirect laying data promptly and accurately.

b. The battery may consist of two or more guns. The usual unit which executes battery fire is the platoon.

c. The meanings of terms are given in paragraph 120.

46. CONDUCT OF BATTERY DRILL. a. Gun positions are indicated to the section leaders and the guns emplaced pointing in the anticipated general direction of fire.

b. All guns are laid parallel by any of the means outlined in chapter 5.

c. After guns are properly laid for direction and ase deflections determined, a series of simulated missions are fired.

d. The following fire commands indicate how such an exercise may be conducted.

(1) BATTERY ADJUST
SMOKE
BASE DEFLECTION

NUMBER THREE ONE ROUND
ONE TWO SIX
FIRE

(2) RIGHT ONE ZERO
ONE THREE EIGHT
FIRE

(3) HE
ONE THREE TWO
FIRE

(4) BATTERY RIGHT
ONE TWO NINE
FIRE

(5) NUMBER ONE: RIGHT SIX, ADD FOUR
NUMBER TWO: RIGHT THREE
NUMBER FOUR: DROP TWO
ON NUMBER THREE CLOSE SIX
BATTERY
ONE ROUND
ONE TWO EIGHT
FIRE

(6) CEASE FIRING, END OF MISSION
ON NUMBER THREE OPEN SIX
RECORD NEW BASE DEFLECTION

e. Upon completion of this exercise, additional simulated firing should be conducted.

f. Initial drill of this type should emphasize precision. Speed will be attained through practice.

CHAPTER 4

MARKSMANSHIP

Section I. GENERAL

47. **PURPOSE.** The purpose of this chapter is to provide thorough and uniform methods of training individuals to deliver prompt and accurate direct fire during combat on stationary or moving targets. Courses of instruction and rules and regulations for the conduct of marksmanship training are included.

48. **FUNDAMENTALS.** To be capable of delivering prompt and accurate fire on stationary or moving targets, the soldier must be thoroughly trained in the following fundamentals:

a. Correct sighting and aiming.
b. Correct positions.
c. Correct trigger manipulation.
d. Knowledge of range estimation.
e. Knowledge of speed estimation.
f. Knowledge of lead estimation.
g. Tracking exercises.

49. **PRIOR TRAINING.** The soldier should be proficient in mechanical training and should be

thoroughly familiar with the operation and use of the rifle accessories.

Section II. PREPARATORY EXERCISES

50. GENERAL. a. The purpose of preparatory exercises is to teach the soldier the essentials of marksmanship, and to develop fixed and correct habits of marksmanship before he begins range practice. A thorough, carefully supervised course in preparatory exercises will conserve time and ammunition during range practice and will inculcate in the individual automatic procedures to eliminate accidents.

b. Preparatory exercises are divided into eight steps. These steps should be taught in the sequence listed below:

(1) Sighting and aiming exercises.
(2) Position exercises.
(3) Trigger manipulation exercises.
(4) Range estimation exercises.
(5) Speed estimation exercises.
(6) Lead estimation exercises.
(7) Tracking exercises.
(8) Examination.

51. SIGHTING AND AIMING EXERCISES. a. Sighting and Aiming with sight M85C. (Direct fire up to 2,100 yards.) For description of sight M85C, see paragraph 24.

(1) *Aiming for range.* Exercises should be con-

ucted on stationary 1000″ "A" rifle targets. The ercise should not involve tracking. The gunner is required to set the correct sight picture for every 100 yards of range (fig. 20).

(2) *Aiming with leads.* The distance by which a target is led is measured from the point of aim, and is equal to the distance the target will travel between the time the projectile leaves the rifle and the time its trajectory crosses the path of the target. This distance is known as lead and varies with the speed and path of the target. Five mils is taken as the unit and is equal to one lead. Three

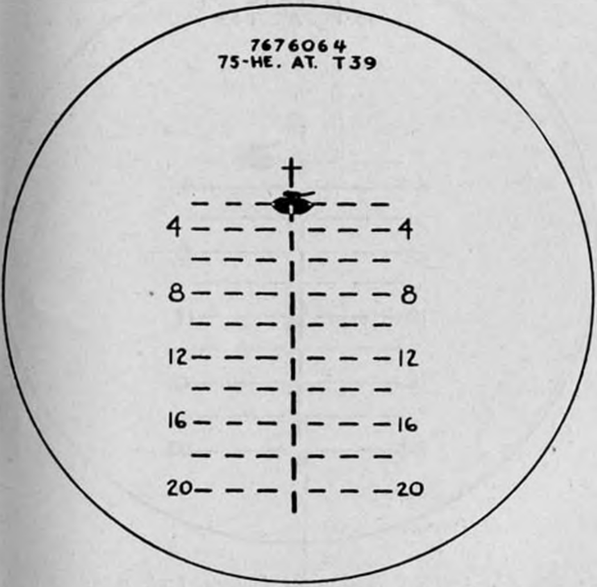


Figure 20. Correct range sight picture, tank 200 yards.

leads (15 mils) are used for each 10 mph that th target is moving when the path of the target at an angle of 45° or greater to the line of fir When the path of the target is at an angle les than 45° to the line of fire, half this number o leads should be used. Exercises are conducte which require the gunner to set appropriate lea markings on a caliber .22 – .30 "A" subcalibe target (1000"). The target remains stationary a a range of 200 yards, but is assumed to be movin right or left at various angles and speeds (fig. 21)

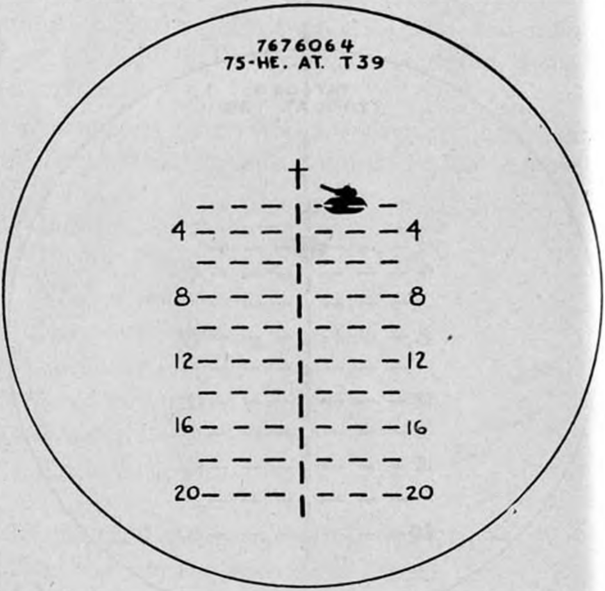


Figure 21. Correct lead sight picture, tank right to left, 3 leads 200 yards.

(3) *Aiming for range and leads.* Range and lead re combined automatically within the telescope a series of horizontal lines extending to the right and left from center at 200-yard intervals. For targets requiring leads at ranges other than those etched on the reticle, interpolation is necessary. Select the appropriate range and lead points on the telescope reticle and project them to an imaginary point of intersection. This aiming point is laid on the center of the target. Each gunner is required to lay the rifle on the target (cal. .22 – .30 "A" subcaliber 1000″) at various ranges and leads. The target remains stationary with an

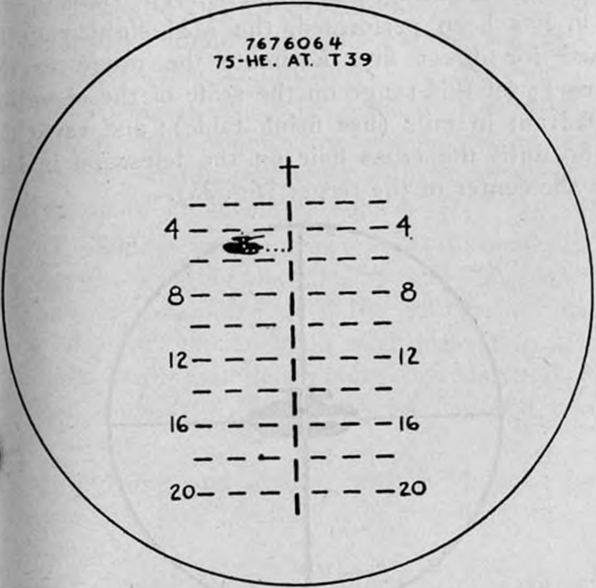


Figure 22. Correct lead to sight picture, tank left to right, 3 leads, 500 yards.

assumed direction and speed being specified in ea case. Ranges and leads requiring interpolati should be included. At least one period of traini will be devoted to use of the lighted reticle accustom all men to sighting and aiming with th telescope during the hours of limited visibili (fig. 22).

b. Sighting and aiming with the M34 sight. Th M34 sight is used for direct fire for ranges ov 2,100 yards.

(1) *Aiming for range.* (*a*) In using the indire fire sight for direct fire, the sight must be fir adjusted for vertical parallelism. This is discusse under boresighting, paragraph 59. When this opera tion has been performed, the M34 sight may b used for direct fire. Estimate the range to th target; set this range on the scale of the elevatio quadrant in mils (use firing table); and raise th tube until the cross hair on the telescope is lai on the center of the target (fig. 23).

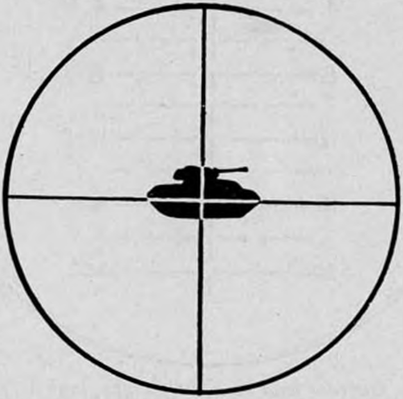


Figure 23. M34, sight reticle and tank.

(*b*) Exercises should be conducted at any range using a stationary 1000″ "A" rifle target with an assumed range over 2,100 yards.

(*c*) It is not to be construed that the M34 sight cannot be used for ranges under 2,100 yards. A direct fire sight (M85C) is furnished for this purpose and can be used more rapidly since leads and ranges are combined automatically on the telescope reticle. However, the M34 sight may be used if desired.

(2) *Aiming with leads using M34 sight for direct fire.* (*a*) Leads may be set off on the sight using the same rule as for direct fire given above. These leads may be applied to the M34 sight by setting the desired number of leads in mils on the scale of the deflection quadrant.

(*b*) Exercises should be included in marksmanship training which require the gunner to set various leads on a stationary target with range, speed, and direction of movement assumed.

(3) *Aiming for range and leads.* A combination of exercises as given in (1)(*b*) and (2)(*b*) above should be conducted until the gunner has reached the desired efficiency in sighting at stationary targets with assumed ranges, speeds, and directions. A 1000″ "A" rifle target may be used at any range.

c. Sighting and aiming with M34 sight for indirect fire. For description of the sight, see paragraph 25.

(1) *Aiming for range.* When firing indirect fire, the range element of the fire command is given

in mils. This conversion is readily available in a firing table. For example: the elevation in mils required for 3,000 yards is 177.3 mils. To aim the rifle for this range, set 100 mils on the elevation scale. This is accomplished when the first graduation above "0" is opposite the index of the elevation scale. By turning the elevation micrometer until 76 mils is opposite the index of the micrometer scale, we have set an elevation of 176 mils on the elevation scale and micrometer. Since the micrometer is graduated in 2-mil increments, we must interpolate the half-way mark between 76 and 78 mils on the elevation micrometer scale to obtain a reading of 77 mils. The .3 mil is dropped since it is less than one-half mil. To complete the operation and produce the desired elevation of the tube, manipulate the elevation handwheel and cradle and raise the tube until the bubble in the longitudinal level is centered.

(2) *Aiming for direction.* When aiming for direction using the indirect fire sight, the initial direction is given as a base deflection for each gun when the battery is put in position to fire. Thereafter, changes in direction are given as references left or right so many mils from base deflection. When the change is left, add the change in mils to the base deflection; when the change is right, subtract the change in mils from the base deflection. The keyword "LARS" (left, add: right, subtract) will assist in remembering whether to add or subtract changes in deflection. For example: the command is BASE DEFLECTION, RIGHT 40. The gunner subtracts 40 mils from his base

deflection and sets this reading on the azimuth scale and azimuth micrometer. He then moves the tube until the vertical cross hair of the telescope reticle is on the left edge of the aiming stake. It is not necessary to check the cross level bubble. However, when placing the gun in position, every effort should be made to level the dial and center the cross level bubble. Thereafter, unless the tube cants to an extreme angle, the cross level bubble is not checked.

52. **POSITIONS.** Instruction in positions includes positions for the gunner and assistant gunner when firing at stationary or moving targets. For positions during firing, see paragraph 42.

53. **TRIGGER MANIPULATION.** The gunner grasps the trigger handle with his right hand, thumb on the trigger, forefinger or middle finger rotating the trigger safety; and with a smooth steady rearward pressure on the trigger, fires the piece. Care must be taken not to throw the rifle off the target or aiming point while rotating the trigger safety or depressing the trigger. The correct sight picture must be held while firing.

54. **RANGE ESTIMATION.** Accurate range estimation is essential to obtaining hits with a minimum expenditure of time and ammunition. Estimation of the range to targets, stationary and moving, should be stressed until the desired proficiency is attained. For methods of training in range estimation see paragraph 79.

55. SPEED ESTIMATION. a. Speed estimatio is an essential phase of preliminary marksmanshi training. The firer must base the number of lea upon his estimation of the speed of the targe Constant practice in estimating the speeds of moving targets is the only method by which the individual can acquire accuracy in speed estimatio Training must include the use of many target at various ranges, speeds, and directions of movement.

b. Exercises in speed estimation should be conducted in the form of an examination with target moving according to a prearranged plan. Initiall the section is shown by demonstration the appearance of different targets moving at announce speeds and ranges. Each man is then require to estimate the speed of targets moving at variou ranges in various directions.

56. LEAD ESTIMATION EXERCISES. Exercises are conducted with targets moving at variou ranges, speeds and directions. Based upon observation of the target, the individual computes th necessary leads in accordance with the method lead determination as given in paragraph 85.

57. TRACKING EXERCISES. When the gunn has become proficient in the previous steps marksmanship, training in tracking moving targe should be conducted on 1000″ ranges with predetermined speeds and ranges. Training should continuous, progressing to vehicles, tanks, et moving first at predetermined ranges and spee and moving finally at undetermined ranges and speeds. Sufficient exercises should be conducted to bring the gunner to a high level of proficiency.

58. EXAMINATION. Before range practice is begun each man should be examined to see that he has attained the desired proficiency. The type of examination need not be the same for all individuals. An oral applicatory examination at the close of each phase of marksmanship, followed by a general review of all phases on the completion of marksmanship training, should be satisfactory.

Section III. BORESIGHTING

59. BORESIGHTING. a. Sight M85C. To boresight the rifle with this sight it is necessary to make the axis of the bore (extended) intersect the line of site at some distant point, preferably a point beyond the range to any likely target. On the muzzle end of the gun there are four notches 90° apart. If threads are stretched across alternate notches, the intersection of the threads defines the axis of the bore at the muzzle end. If the breech operating handle assembly is removed from the breechblock, the firing pin aperture defines the axis of the bore at the breech end when the breech is closed. (The cut-off base of an empty shell case with the primer punched out can be inserted into the cone, and the primer aperture used in place of the firing pin aperture.) By elevating and traversing the piece, the axis of the bore can then be aimed at the aiming point. To place the reticle cross on the same aiming point it is necessary to loosen the elevation and deflection worm locking nuts (fig. 24). When these are loose, the elevation and deflection worms on the telescope mount can be turned with a screw driver to adjust the position of the reticle cross with respect to the aiming point. When the reticle cross and the axis of the bore are on the same aiming point, the piece is boresighted.

b. Sight M34. (1) *Adjustment of the elevation quadrant.* If the elevation quadrant is in adjustment,

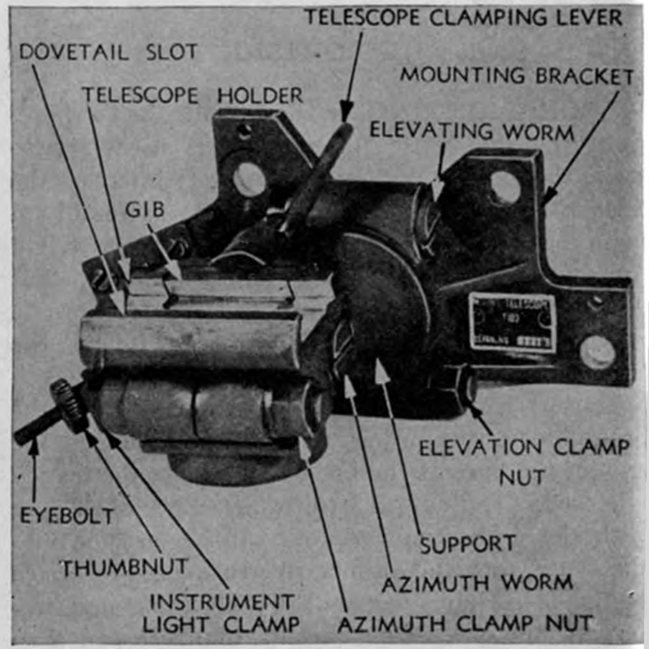

TELESCOPE CLAMPING LEVER
DOVETAIL SLOT
MOUNTING BRACKET
TELESCOPE HOLDER
ELEVATING WORM
GIB
ELEVATION CLAMP NUT
EYEBOLT
SUPPORT
THUMBNUT
AZIMUTH WORM
INSTRUMENT LIGHT CLAMP
AZIMUTH CLAMP NUT

Figure 24. Sight bracket showing locking nuts and worms.

the tube will be elevated to the number of mils indicated on the elevation scale and micrometer when the longitudinal bubble is leveled. To test the adjustment, set the scale and micrometer of the gunner's quadrant to zero, place the quadrant on the gun and by means of the elevating mechanism on the gun, level the bubble on the gunner's quadrant. Level the longitudinal bubble on the elevation quadrant of sight M34 by means of the elevation micrometer knob on the sight. The elevation and micrometer scale should then read zero. If they do not, they must be made to read zero as follows: loosen the screw in each end of the scale and shift the scale until it reads zero; tighten the screws. Loosen the three small screws in the end of the elevating knob and while holding the knob to prevent it from moving, shift the micrometer scale to read zero; tighten the screws. Check the settings with the level bubble to make sure that the elevation micrometer knob did not turn when the screws were being tightened.

(2) *Adjustment of cross level.* If adjustment of the cross level is necessary it must be made by ordnance personnel.

(3) *Adjustment of deflection scale and micrometer.* (*a*) Aim the axis of the bore at an aiming point.

(*b*) Look through the telescope and, using the azimuth worm knob, bring the vertical line of the reticle to bear exactly on the aiming point. The azimuth scale and micrometer should then read zero. If they do not, they must be made to read zero as follows: Loosen the four screws in the clamping ring and slip the scale until it reads zero; tighten the screws. Loosen the large clamping nut in the end of the micrometer knob, and while holding the knob to prevent it from turning, slip the micrometer scale to read zero; tighten the clamping nut. Check the readings and the alinement on the target to see that the knob did not turn while the clamping nut was being tightened.

(4) *Adjustment for vertical parallelism.* If it is desired to use the elbow telescope for direct fire, the line of sight must be adjusted for vertical parallelism. To make this adjustment, loosen the elevating clamping nut and elevate or depress the telescope until the cross hair of the reticle falls on the aiming point.

Section IV. QUALIFICATION COURSES

60. GENERAL. a. Personnel who are to fire for qualification should have completed training in the following subjects:

(1) *Mechanical training.* (*a*) Nomenclature, disassembly and assembly.

(*b*) Care and cleaning.

(*c*) Functioning.

(*d*) Stoppages and immediate action.

(*e*) Fire control instruments.

(*f*) Boresighting (with both direct and indirect sight).

(2) *Crew drill.*

(3) *Preliminary marksmanship.* (*a*) Sighting and aiming.

(*b*) Trigger manipulation.

(*c*) Positions.

(*d*) Fire commands.

b. Qualification courses for the 75-mm rifle consist of the following:

(1) *Course A*—1000″ subcaliber, mid-range subcaliber, and service firing. Course A is for use at posts, camps, and stations where range facilities permit the firing of service ammunition in accordance with the provisions of AR 750–10.

(2) *Course B*—1000″ subcaliber and mid-range subcaliber firing. Course B is for use where range facilities prohibit the firing of service ammunition.

(3) *Course C*—1000″ subcaliber firing. Course C is for use where range facilities include only indoor ranges or miniature outdoor ranges.

c. Instruction practice is not limited to the firing tables found in paragraph 61**e**. Time, facilities, and ammunition allowances will determine the amount of firing.

d. The fundamentals emphasized in the qualification courses are:

(1) Rapid and accurate delivery of the initial round.

(2) Rapid and accurate delivery of the subsequent round.

(3) Rapid determination of speed, lead, and range.

e. For safety precautions, range procedure, operational diagrams, and conduct of fire, see section V, this chapter.

61. **COURSE A. a. General.** General instructio practice consists of firing tables I and III twice and tables II and IV three times. Record practice consists of firing tables I, II, III, IV, and V once (see **e** below).

b. Equipment.

1 — 75—mm rifle, complete with sight M85
and mounted on MG tripod M1917A1.

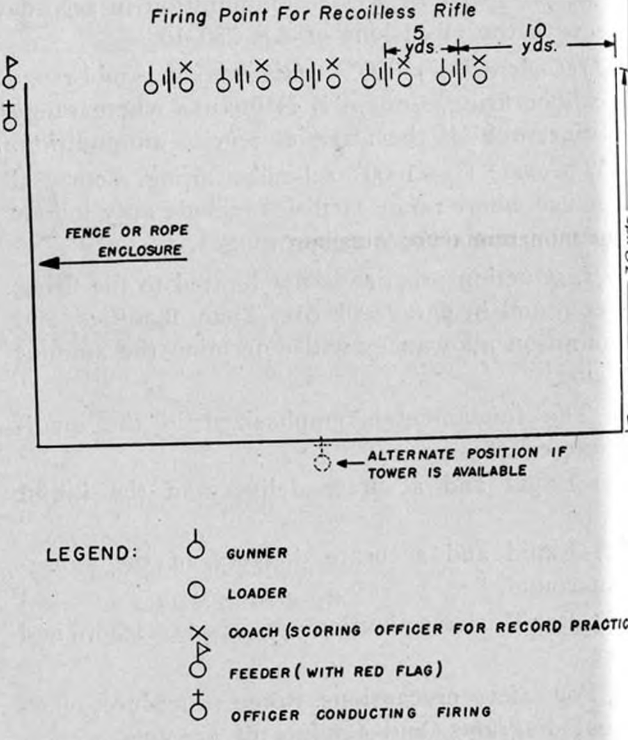

Firing Point For Recoilless Rifle
5 yds.
10 yds.
FENCE OR ROPE ENCLOSURE
ALTERNATE POSITION IF TOWER IS AVAILABLE
LEGEND:
GUNNER
LOADER
COACH (SCORING OFFICER FOR RECORD PRACTIC
FEEDER (WITH RED FLAG)
OFFICER CONDUCTING FIRING

Figure 25. Range organization.

1 — Screw driver per rifle.
1 — Subcaliber device per rifle.
1 — Crescent wrench per rifle.
Boresighting equipment.
Stop watch.
Firing tables.

c. Conditions. (1) Organization of the range is in accordance with the provisions of paragraph 69 and AR 750–10.

(2) Rifles are emplaced with tools nearby in accordance with operational diagram (fig. 25).

d. Procedure. The gunner is permitted 10 rounds to zero his rifle. Five rounds of caliber .30 carbine ball ammunition are fired at 1000″ target "A" (rifle). Using an assumed range of 700 yards, the sight is then adjusted on the center of impact. The remaining five rounds are then fired to confirm the adjustment.

e. Tables.

Table I. 1000″ subcaliber stationary target

No. Rounds	*Time*	*Target*	*Score*	*Remarks*
4	No limit	Rifle A	20	Four 1000″ "A" (rifle) targets are placed on a machine gun target frame at least 12″ apart laterally and 6″ vertically, forming a rectangle.
4	No limit	Rifle A	20	
4	No limit	Rifle A	20	
4	No limit	Rifle A	20	
16		Total:	80	

Table II. 1000″ subcaliber moving target

No. rounds	*Speed Inches/sec*	*Time exposed (sec)*	*Lead*	*Maximum score*	*Remarks*
2	12	41	0	10	L to R
2	12	41	0	10	R to L
2	16	31	1	10	L to R
2	16	31	1	10	R to L
2	24	21	2	10	L to R
2	24	21	2	10	R to L
12		Total:		60	

(1) Target is 1000″ "A" (rifle) target.

(2) *Commands by officer in charge of firing.*

(*a*) *Preliminary commands*:

LAY ON AIMING STAKE (in center of target run).

ONE ROUND, SUBCALIBER, LOAD.

(All guns lay on aiming stake and load one round.)

(*b*) *Fire command*:

MOVING TARGET
SUBCALIBER
LEFT (RIGHT) FRONT
TOP (CENTER or BOTTOM) TANK
SEVEN HUNDRED
ONE LEAD
FIRE

Table III. Known distance, subcaliber stationary target

No. rounds	*Range*	*Target*	*Maximum Score*	*Remarks*
10	All	See below		Targeting allowance.
5	200	Prone "F" M–1917 complete.	25	
5	300	Prone "F" M–1917 complete.	25	All firing on this table is done with tracer ammunition.
5	400	Kneeling "E" M–1917 complete.	25	
25		Total:	75	

Scoring: Targets will be scored by personnel in the pits at the 200, 300, and 400 yard lines. Scoring personnel in the pits should have telephone communication with the firing point. If the facilities described above are not available, a known distance rifle range with "E" targets may be substituted.

Table IV. Subcaliber moving target

No. rounds	*Lead*	*Speed*	*Maximum score*	*Remarks*
4	1	10 mph	20	L to R
4	1	10 mph	20	R to L
4	2	15 mph	20	L to R
4	2	15 mph	20	R to L
16		Total:	80	

Note. Range from firing point to target runway is 450 yards. Length of target run is 300 yards. Target to be used is a tank, or where not available, a target as described in fig. 26 may be substituted. Procedure is identical with table II. Tracer ammunition is used in this table. When a tank is used, scoring is accomplished by observation of strike of tracer by scorer. When a towed target is substituted, the target will be marked rather than scored by observation from the firing line.

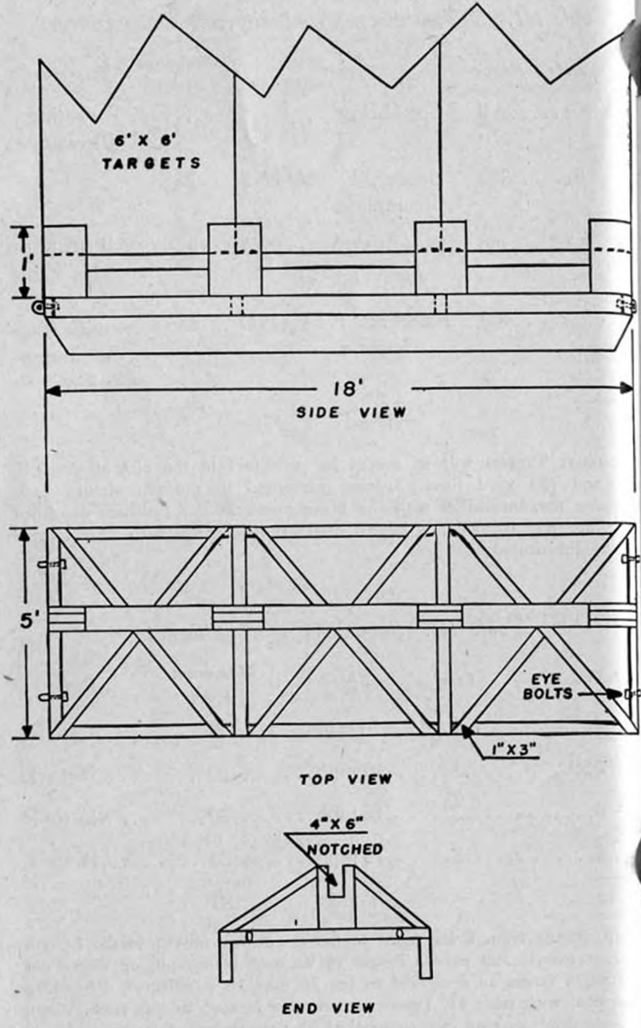

6' X 6'
TARGETS
1'
18'
SIDE VIEW
5'
EYE BOLTS
1" X 3"
TOP VIEW
4" X 6"
NOTCHED
END VIEW
ALL CONSTRUCTION 2x4's EXCEPT AS NOTED

Figure 26. Sketch of target frame.

Table V. Service firing, known distance

. rounds	*Range*	*Target*	*Maximum score*
4	400 yds.	55 gal. drum	20
4	800 yds.	3′ x 5′ log barrier	20
8		Total:	40

Note. The first round fired at either range does not count for score, whether it is a hit or not. The gunner is credited with ten points for the first hit he receives after the first round fired. He ceases fire after this hit and receives five points for each unexpended round of the original four rounds.

(3) *Ammunition.* Target practice ammunition should be used. Inert ammunition is an authorized substitute.

(4) *Scoring.* Scoring is accomplished by the scorer's observation of the strike of the projectile.

62. **COURSE B. a.** Course B will consist of tables I, II, III, and IV.

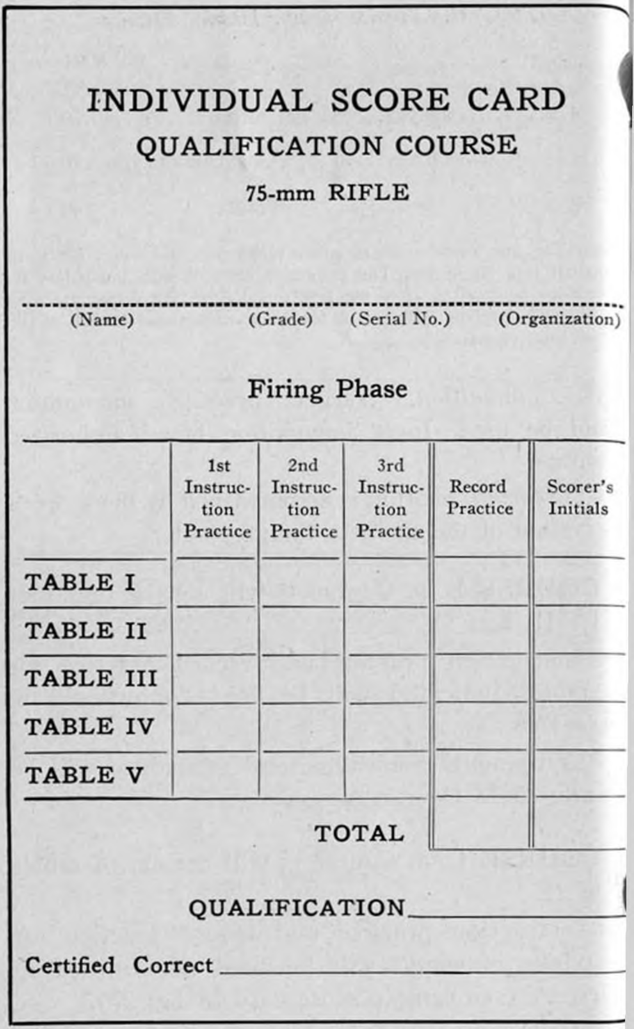
b. Instruction practice and record practice for the tables indicated will be fired as outlined in Course A.

c. Equipment, conditions, and procedure will be as outlined in Course A.

3. **COURSE C. a.** Course C will consist of tables and II.

b. Instruction practice and record practice for the tables indicated will be fired as outlined in Course A (see sample score card in fig. 27).

c. Equipment, conditions, and procedure will be as outlined in Course A.



INDIVIDUAL SCORE CARD
QUALIFICATION COURSE
75-mm RIFLE

....
(Name) (Grade) (Serial No.) (Organization)

Firing Phase

	1st Instruction Practice	2nd Instruction Practice	3rd Instruction Practice	Record Practice	Scorer's Initials
TABLE I					
TABLE II					
TABLE III					
TABLE IV					
TABLE V					
			TOTAL		

QUALIFICATION ____________________

Certified Correct ____________________

Figure 27. Sample score card.

64. **QUALIFICATION SCORES***. **a. Course A.**

Expert	260–335
1st Class Gunner	240–259
2nd Class Gunner	190–239
Unqualified	189 or below

b. Course B.

Expert	230–295
1st Class Gunner	212–229
2nd Class Gunner	160–211
Unqualified	159 or below

c. Course C.

Expert	125–140
1st Class Gunner	110–124
2nd Class Gunner	80–109
Unqualified	79 or below.

Section V. SAFETY PRECAUTIONS AND PROCEDURE FOR FIRING

65. **GENERAL. a.** Because of the danger to personnel, resulting from the back blast of recoilless weapons, extreme care must be exercised in all phases of instruction. From the earliest stages of training this danger must be emphasized. Any crew drill, position exercises, tracking exercises, or subcaliber firing must be conducted as though actual service ammunition were being fired.

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*Organization commanders should, prior to range practice, assure themselves that the qualification scores agree with the latest published regulations, and should make changes in this manual in pencil to agree with such regulations.

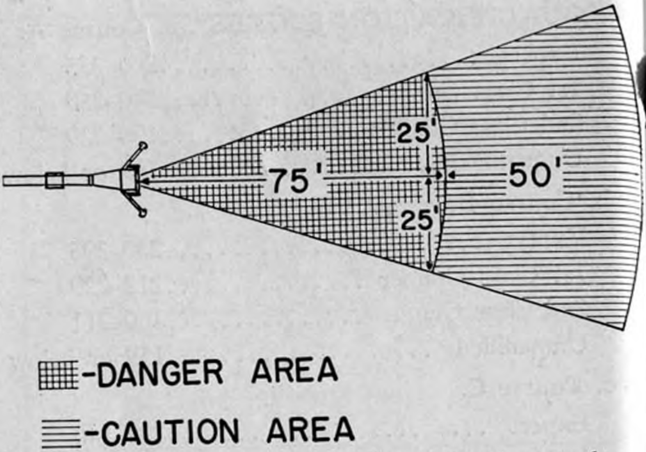


Figure 28. Diagram showing danger area in rear of 75-mm rifle, M–20.

b. The danger zone (fig. 28) is triangular shaped, extends approximately 75 feet to the rear of the point of emplacement, and covers a space of 25 feet on either side of the axis of the emplaced rifle at it widest point. No personnel should face the weapon within 125 feet of the rear of its breech because of danger of flying particles thrown up by the blast action.

c. It is dangerous to operating personnel to fire the weapon from closely confined spaces, such as dugouts or foxholes, because of the concussion from the backblast. The weapons can be fired from semiconfined spaces, such as the rooms of buildings, without danger, provided the room is large, with sufficient openings to allow rapid escape of the powder gases. Firing can be accomplished from any semiconfined space provided there is an opening directly behind the breech through which the back blast can pass. Firing from rooms wherein there is a wall too close to the breech will result in damage to the wall and discomfort to the operating personnel even when there are sufficient outlets for the gases to escape.

d. Most conventional type weapon emplacements are unsuitable for this weapon. Any emplacement where there is an obstruction too near the breech is unsuitable because the obstruction will tend to deflect the concussion toward the operating personnel. Most suitable types of emplacements are those which leave the gun exposed, or semi-exposed, with no obstruction behind the breech, and provide for cover for the operating personnel on either side of the gun. (For details of emplacements see FM 5–15.)

e. All firing is controlled by definite fire commands.

f. During the initial phases of instruction firing, the officer conducting firing may, at his discretion, reduce the speed of the target and the number of rounds fired in each run. The object of this procedure is to increase confidence and place emphasis on manipulation and accuracy.

g. All exercises are to be fired in the order in which they are listed in the tables (par. 61**e**).

h. During instruction firing only, moving target firing may be preceded by one or more dry runs.

66. **DUTIES OF PERSONNEL. a. Officer in charge.** The officer in charge of range practice, detailed by the unit commander, is responsible for —

(1) Assignment, coordination, and supervision of the firing line to emphasize safe and smooth operation of all firing.

(2) Issuance of fire commands and general instructions to the firing line.

(3) Enforcement of safety precautions prescribed in AR 750–10 and this manual.

(4) Organization of the range.

b. Company commander. The company commander is responsible for the efficiency of the marksmanship training in his organization and for the conduct of its firing.

c. Scoring officers. (1) Scoring officers are detailed to supervise record practice firing. Officers for this duty will be detailed from organizations other than the one firing. They will familiarize themselves thoroughly with their duties and with firing procedure prior to the date of record practice firing.

(2) Scoring officers will perform the following specific duties:

(*a*) Check dimensions of the targets, aiming silhouettes, and scoring spaces.

(*b*) Inspect each target before firing to insure that it contains no unpasted shot holes.

(*c*) Count number of rounds of ammunition t be fired by the gunner for each exercise.

(*d*) See that firing is being conducted in accordance with the prescribed procedure.

(*e*) Check time of exposure on moving target runs and render a decision in the event of irregularities.

(*f*) Verify and render decisions on all misfires and malfunctions at the guns under his jurisdiction.

(*g*) Render a decision in the event of breakage or stoppage in any of the range apparatus.

(*h*) Score targets on each exercise fired and record the score.

d. Coaches. During all preparatory training practice a coach will be present at each gun to instruct and assist the gunner. No coach will be present at the gun for record firing. The specific duties of the coach are as follows:

(1) Require each gunner and loader to observe all pertinent individual and general safety precautions, and insure compliance with instructions pertaining to the service of the piece.

(2) See that the proper number of rounds is present at the piece for each exercise.

(3) Supervise generally the work at the gun and make sure that the commands are executed properly. Repeat orders and instructions where necessary to insure correct understanding and timely execution.

(4) Report all misfires, malfunctions, or discrepancies to the officer conducting firing.

(5) Score the targets and critique the firing.

e. Loader. (1) The primary duty of the loader is to serve the piece during all firing exercises. During instruction practice he may also act as assistant coach. During record firing he will not coach or instruct the gunner in any way.

(2) The specific duties of the loader are as follows:

(*a*) Load the rifle in accordance with the commands of the officer conducting firing.

(*b*) Tap the gunner and report "up" when the weapon is loaded and he is completely clear of the breech.

(*c*) Signal "ready" to the officer conducting the firing.

(*d*) Repeat all orders to unload, cease firing, and clear gun.

(*e*) Announce to the gunner the number of rounds to be fired on each exercise when required.

f. Feeder. (1) The feeder controls the movement of personnel to and from the firing line and allows no movement behind the line of guns except under the direction of the officer conducting firing.

(2) The specific duties of the feeder are as follows:

(*a*) To allow no personnel to move to or from the firing line except when all breeches are open and personnel are standing free of the gun.

(*b*) After completion of firing by each order, to send subsequent orders to the guns on command of the officer conducting firing.

(*c*) To raise a red flag at the end of the firing line except when all breeches are open, all personnel are clear of the guns, and instructions are received from the officer conducting firing.

(*d*) To permit no personnel to move behind the guns while the red flag is raised.

67. **ORGANIZATION.** **a.** Organization of the firing line is in accordance with figure 25.

b. Duties of personnel are as outlined in paragraph 66.

c. No personnel are allowed at any time to enter the fenced or roped off enclosure except those actually required on the firing line.

d. No personnel may enter or leave the firing line and no movement between guns will be allowed when the red flag is raised.

e. Prior to any firing each gun will be carefully checked by an officer to insure that it is in firing condition.

68. INSTRUCTION PRACTICE FIRING. a. General. (1) Before firing, the officer in charge of firing gives a description of the range and announces specific instructions pertaining to firing procedure.

(2) Guns are numbered from right to left.

(3) The coach, loader, and gunner take positions at the gun. The gunner tests the firing, elevating and traversing mechanisms; the loader secures the necessary ammunition.

(4) When all guns are prepared for firing and the safety regulations checked, the officer conducting firing gives the fire command.

(5) At the completion of an exercise the officer conducting firing commands: CEASE FIRING. The loader rapidly unloads the gun, all personnel stand clear of the gun, and the loader then signals to the officer in charge that this has been accomplished.

b. Stationary target firing. An example of the sequence of a fire command is as follows: FIRE MISSION, SUBCALIBER, FRONT, TARGET, SEVEN HUNDRED. When all guns have signalled "Ready," the officer conducting firing commands: FIRE. Each gunner fires as directed until his ammunition is used up or until the command, CEASE FIRING is given.

c. Moving target firing. An example of the sequence of a fire command is as follows: GUN ON AIMING STAKE, LOAD. When all guns have signalled "Ready," a subsequent fire command is given as follows: MOVING TARGET, SUBCALIBER, LEFT FRONT, TANK, SEVEN HUNDRED, TWO LEADS, FIRE. When the target has completed its run, the command CEASE FIRING is given. The same type of sequence is used for the return run.

d. Record practice firing. (1) The same procedure as that prescribed for instruction practice firing will, except as noted below, be employed for record firing.

(2) Each man will complete the prescribed instruction practice firing for the course specified prior to record practice firing.

(3) As a rule, record practice firing will not be executed on the same day that any portion of instruction practice is fired. However, when the time allotted is very limited, the unit commander may authorize record practice firing on the same day.

(4) Before firing any exercise for record, the gunner will be given a reasonable length of time

to check the condition of his gun, sight, and ammunition.

(5) The gunner will be required to boresight or target his own weapon prior to any record firing.

(6) The target speed or allotted time will be given each gunner prior to firing.

(7) In record practice firing, when a misfire, stoppage, or malfunction occurs, the gunner or loader will hold up his hand and call, "Stoppage." Thereafter, neither the loader nor gunner will touch the gun until so instructed by the scoring officer who will examine the gun.

(8) If a misfire, stoppage, or malfunction occurs through no fault of the gunner, the score will be disregarded and the gunner permitted to refire the exercise.

(9) Decisions to disregard scores or to authorize refiring of portions of the course rest with the scoring officer.

(10) If a misfire or malfunction is manifestly the fault of the gunner, he will not be permitted to refire the portion of the course affected.

69. SCORING AN INDIVIDUAL FOR QUALIFICATION. a. Any departure from the mandatory provisions of this course will disqualify the man affected for qualification.

b. After a man has started an exercise, all shots fired by him will count as a part of the exercise.

c. The gunner who fires at the wrong target or scoring space will be given credit only for those hits which strike the proper target or scorin space.

d. A hit will be scored for each bullet hole foun in a target or scoring space, except that no mor than the prescribed number of shots will b counted. In moving target firing wherein a tan is used, observation of tracer strike on the tan will count as a hit. In field service firing, observation of strike on the target will count as a hi The target need not be marked.

e. For 1000″ firing, the name of the gunner wi be placed on each target before firing. Excep under the supervision of the scoring officer, n person will handle any target until it has bee scored.

f. A bullet hole which touches the line of scoring space will be classed as a hit.

g. For moving target firing, ammunition no fired during the time of exposure of the targe will be forfeited.

h. Holes made by ricocheting bullets, rocks, o other foreign matter will not be counted.

i. Each individual entry for record practice wi be made on the score card in ink or indelible penci and will be authenticated by the scoring office Erasures are not permitted. Alterations will b made only by the scoring officer, and such alterations will be authenticated by that officer.

CHAPTER 5

TECHNIQUE OF DIRECT FIRE

Section I. GENERAL

70. **DEFINITIONS.** The operation involved in the application of effective fire on a target is called "technique of fire." The operation involved in pointing a gun for direction and elevation by directing the line of sighting on a target visible to the gunner is called "direct laying." Since the primary mission of this weapon is direct fire at point targets, the technique of direct fire is particularly important.

71. **SCOPE.** Direct laying involves a knowledge of the subjects listed below:

a. Characteristics of fire.
b. Range, speed, and lead determination.
c. Target designation.
d. Fire control.
e. Fire commands.
f. Range cards.

Section II. CHARACTERISTICS OF FIRE

72. **TRAJECTORY.** The trajectory is the imaginary line traced by the projectile from the gun to

the point of impact. The 75-mm rifle M20 is classe as a flat trajectory weapon, but because of th action of the air resistance and the force of gravit on the projectile the trajectory is actually a curv The angle of fall is greater than the angle of elevation and the projectile reaches its maximu ordinate (highest point) closer to the point o impact than to the gun (fig. 29). A tangent t the trajectory at the point of impact is called th line of impact. The angle between the line o impact and the ground at the point of impact i called the angle of impact.

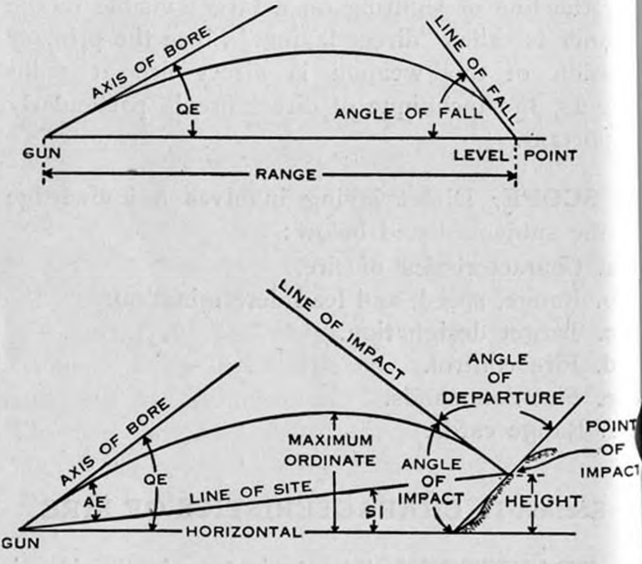

AXIS OF BORE
QE
LINE OF FALL
ANGLE OF FALL
GUN
LEVEL POINT
RANGE
LINE OF IMPACT
ANGLE
OF
DEPARTURE
AXIS OF BORE
MAXIMUM
ORDINATE
POINT
OF
IMPACT
ANGLE
OF
IMPACT
QE
AE
LINE OF SITE
SI
HEIGHT
GUN
HORIZONTAL

Figure 29. Elements of trajectory.

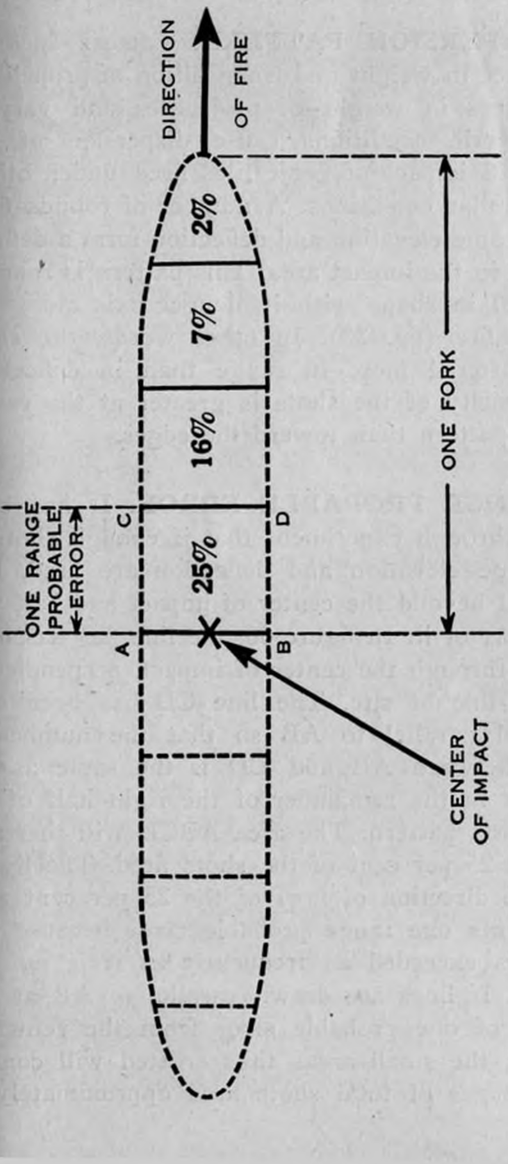

DIRECTION OF FIRE
ONE RANGE PROBABLE ERROR
A
B
C
D
25%
16%
7%
2%
ONE FORK
CENTER OF IMPACT

Figure 30. Dispersion pattern.

73. DISPERSION PATTERN. Factors such as difference in weight and composition of propellant, differences in weight of projectiles and varying atmospheric conditions cause dispersion of the points of impact of projectiles fired under otherwise similar conditions. A number of rounds fired at the same elevation and deflection form a definite pattern in the impact area. This pattern is roughly elliptical in shape with its longer axis along the line of fire (fig. 30). In other words, the shots are scattered more in range than in deflection. The density of the shots is greater at the center of the pattern than toward the edges.

74. RANGE PROBABLE ERROR. It has been found through experiment that if enough shots at the same elevation and deflection are fired, half will fall beyond the center of impact and half will fall short of it. In figure 30, the line AB has been drawn through the center of impact, perpendicular to the line of site. The line CD has been constructed parallel to AB so that the number of shots between AB and CD is the same as the number in the remainder of the right half of the dispersion pattern. The area ABCD will therefore contain 25 per cent of the shots fired. The length (in the direction of fire) of the 25 per cent zone represents one range probable error because this error is exceeded as frequently as it is not exceeded. If lines are drawn parallel to AB at distances of one probable error from the center of impact, the small areas thus created will contain percentages of total shots fired approximately as own in figure 30. Eight probable errors (four n either side of the center of impact) will cover the dispersion pattern. The value in yards of a range probable error, which value varies directly with the range from the gun to the center of impact, is given in Firing Table 75–BB–1 (abridged).

75. **FORK.** A fork is the change in elevation necessary to move the center of impact four probable errors.

Section III. RANGE DETERMINATION

76. **GENERAL.** The ability to determine range accurately may be the factor which decides whether or not a target will be hit. It is probable that the length of time a gun will be able to continue firing from a direct fire position will be very limited, in which case it becomes vitally important to arrive at the correct range determination at the earliest possible moment. Practice in determining ranges by most of the methods explained in the following paragraphs will usually improve ccuracy.

77. **METHODS OF RANGE DETERMINATION.** Ranges are determined by—

a. Taking the range from a map.

b. Estimating distance by eye.

c. Obtaining the range from other units.

d. Firing the gun.

e. Measuring the range on the ground.

78. TAKING RANGE FROM A MAP. The accuracy of this method will depend on the skill of the person reading the map and the accuracy of the map itself. The distance gun-target is measured on the map and, by means of the map scale, the measured distance is converted into yards of range.

79. ESTIMATING DISTANCE BY EYE. a. Estimating range by eye is the quickest method. The degree of accuracy depends on the observer and on his training and experience. In many cases it will be the only possible means whereby ranges can be determined. Accuracy can be attained through exercises which require the student to observe a measured 100-yard marked distance from various angles and from various ranges. After he has attained a mental picture of what 100 yards looks like from these various angles and ranges, he is required to estimate an unknown distance. He does this by applying successively his mental 100-yard "yardstick" to the range to be estimated. For ranges over 500 yards the observer should pick out a point which is half way, estimate the distance to the half way point, and multiply th answer by two.

b. Objects appear closer or farther away with different conditions of light and terrain. The effect of these conditions on the appearance of the 100-yard unit of measure is, however, negligible. Whenever the appearance of objects is used as a basis for range estimation, the observer must make allowance for the effects noted below:

(1) Objects seem nearer—

(*a*) When the object is in a bright light.

(*b*) When the color of the object contrasts sharply with the color of the background.

(*c*) When looking over water, snow, or a uniform surface like a wheat field.

(*d*) When looking from a height downward.

(*e*) In the clear atmosphere of high altitudes.

(*f*) When looking over a depression, most of which is hidden.

(2) Objects seem more distant when—

(*a*) Looking over a depression all of which is visible.

(*b*) There is poor light or fog.

(*c*) Only a small part of the object can be seen.

(*d*) Looking from low ground.

80. OBTAINING RANGE FROM OTHER UNITS. Often a unit being relieved from a combat position will have range cards, along with other information, to be turned over to the relieving unit. Other units of the same organization may have the desired information. This source of information is usually reliable, especially if the other unit has tested it.

81. FIRING THE GUN. The gunner fires at the estimated range and, by observation, he adjusts until he brings fire to bear on the target. He then reads the range from the sight reticle.

82. MEASURING THE RANGE ON THE GROUND. This method presupposes that the situation will permit the observer to traverse the ground. If this situation exists, the observer may pace off the range, or measure it with tape or speedometer.

Section IV.

SPEED AND LEAD DETERMINATION

83. GENERAL. Speed and lead determination are very closely allied since the observer cannot arrive at the correct lead estimation without first having correctly estimated the speed.

84. SPEED DETERMINATION. Constant practice in estimating speeds of vehicles is the only method by which the squad can acquire accuracy in speed estimation. It is unlikely that the members of the squad will have any instruments with which to measure the speed of moving targets. Their success in arriving at reasonably correct estimates will be in direct proportion to the amount of their training and experience.

85. LEAD DETERMINATION. a. The distance by which a target is led is equal to the distance the target will travel between the time the projectile leaves the gun and the time its trajectory crosses the path of the target. The telescope with which this gun is equipped provides measurement of angular leads. Leads, therefore, will vary with the speed and direction of movement of the target, but not with range.

b. It has been found that the ballistic qualities of this weapon are such that three angular leads should be allowed for each 10 mph of speed that the target is moving perpendicular to the line of sighting. The angle at which the target is moving will alter the number of leads to be taken as follows: for targets traveling at an angle of 45° or less to the line of sighting, use half the leads determined for the estimated speed; for targets traveling directly toward or away from the gun, no lateral leads are necessary.

Section V. TARGET DESIGNATION

86. **PRELIMINARY TRAINING.** As a preliminary to practical work in target designation, the members of the 75-mm rifle crew must have a knowledge of the military and topographical terms employed in designating targets; for example, crest, hill, draw, cut, ridge, cross-roads, right, left, flank, and column. They should also be instructed in the meaning and use of such terms as horizontal, vertical, above, below, rectangle, square, triangle, mil, yard, and pace. Finally, a thorough course in visual training and range estimation should be given. The crew member must be taught to use his eyes and retain mental pictures of what he sees.

87. **METHODS OF DESIGNATING TARGETS.** Targets can be designated by—

Oral designation.

Firing the gun.

Laying the gun.

The choice of method will be dependent somewhat on the expediency required by the situation.

88. ORAL DESIGNATION. a. General. By this method the target designation element is given orally; however, arm signals and pointing, where applicable, take the place of or supplement the spoken word. The essential parts of an oral designation are announced in the following sequence:

Direction.

Description of target.

Range.

b. Direction. Wherever practicable, the direction should be given simply by pointing, using only such words as may be necessary. 'Front" is understood as the direction in which the muzzle points, and directions varying therefrom by successive angles of 45° are designated as "right (left) front," "right (left) flank," "right (left) rear," and "rear." The clock system of indicating direction may also be used. In this system the observer imagines himself standing in the center of a clock dial. Front will then be twelve o'clock; rear, six o'clock; right flank, 3 o'clock; left flank, 9 o'clock; etc. (fig. 31). One of the best methods of designating very obscure targets is to use successive reference points. A clearly distinguishable reference is first designated. Rapid recognition of such references is facilitated by previous indication of certain landmarks within the sector of fire, together with an understanding

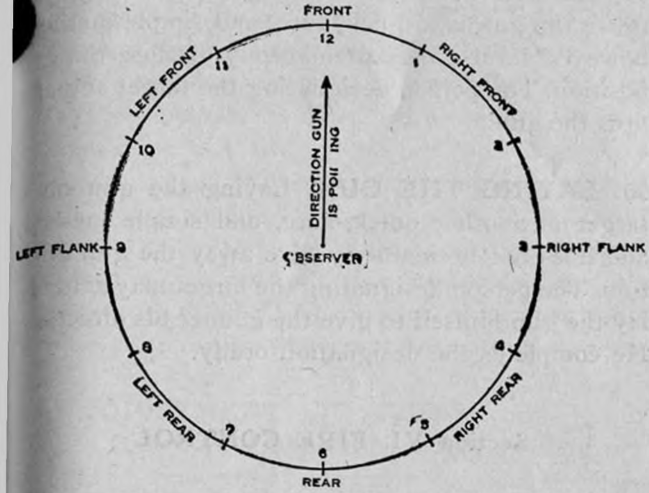

FRONT
12
1
RIGHT FRONT
2
3
RIGHT FLANK
4
RIGHT REAR
5
6
REAR
7
LEFT REAR
8
9
LEFT FLANK
10
LEFT FRONT
11
DIRECTION GUN IS POINTING
OBSERVER

Figure 31. Diagram of clock system of indicating direction.

of the descriptive terms to be applied to designate the landmark. The gunner is then led step by step to the target by naming successive reference points until his line of sighting is brought on the target.

c. **Description of target.** Usually a word or two is sufficient to describe the target; for example: achine gun, tank, pillbox. If reference points are cluded in the order, the word "Target" precedes the descriptive words.

d. **Range.** The range is announced by the command RANGE followed by a statement of the yardage, such as EIGHT HUNDRED. In the fire command the word RANGE is omitted and the range is announced simply as EIGHT HUNDRED.

89. FIRING THE GUN. Designating a target b firing the gun is a quick, sure, and simple method however, its use may prematurely disclose the gu position. The person designating the target actually fires the gun.

90. LAYING THE GUN. Laying the gun on target is another quick, sure, and simple method and does not prematurely give away the gun position. The person designating the target may actually lay the gun himself to give the gunner his direction He completes the designation orally.

Section VI. FIRE CONTROL

91. GENERAL. a. Fire control implies the ability of the leader to open fire at the instant he desires, adjust the fire of his gun or guns upon the target, shift it from one target to another, regulate its rate, and cease fire at will. He must be able to do all of these things promptly if the fire is to be effective. Lack of proper fire control results in loss of surprise effect, premature disclosure of position, application of fire on unimportant targets, loss of time in securing adjustment, and wastage of ammunition.

b. Fire control is founded primarily on thorough discipline and technical training. There must be sufficient flexibility to provide for adequate decentralization in order to compensate for the difficulties encountered in firing guns from widely separated positions.

92. **CHAIN OF FIRE CONTROL.** The commander esponsible for the employment of the guns issues his orders relative to their use direct to the platoon leader. The platoon leader in turn gives fire commands to his section leaders, and they in turn communicate their own commands to their gunners. Because of such factors as noise, semi-isolation of firing compartments, limited vision, and fleeting opportunity, fire control must be based on simple methods to insure effective execution and the engagement of new and unexpected targets which appear after the unit becomes engaged.

93. **ADJUSTMENT OF FIRE.** Normally for ranges less than 1,000 yards, direct readings for deflection, and estimated range corrections necessary to bring the burst to the target will be employed. Where possible the gunner will, under the supervision of the squad leader, make his own corrections and apply them to the weapon without command. The squad leader will issue subsequent commands, when, in his estimation, speed or effectiveness of fire can be enhanced by so doing. For ranges in excess of 1,000 yards the squad leader issues subsequent commands using the bracketing method of adjustment for ange, and direct reading for deflection, unless his knowledge of the terrain indicates that the method outlined for a range of less than 1,000 yards will more expeditiously place fire on the target.

94. **OVERHEAD FIRE.** a. Overhead fire is fire delivered over the heads of friendly troops. The

75-mm rifle M20 is capable of delivering this typ of fire provided it is clamped and in a stabl stationary position.

b. Overhead fire must pass a safe, carefully deter-mined distance above the friendly troops over whose heads it is to be delivered; that is, the minimum clearance or safety angle must be accurately established. The minimum clearance for ranges up to 1,000 yards is determined as follows (fig. 32):

Gunner's Rule

(1) Lay the gun on the target with the correct sight setting to hit the target.

(2) Without disturbing the lay of the piece, sight down the reticle scale to the 1,200-yard graduation and fix the point where the line of sighting strikes the ground. If friendly troops are at or beyond this point, it is unsafe to fire. Overhead fire can be delivered until friendly troops reach this point.

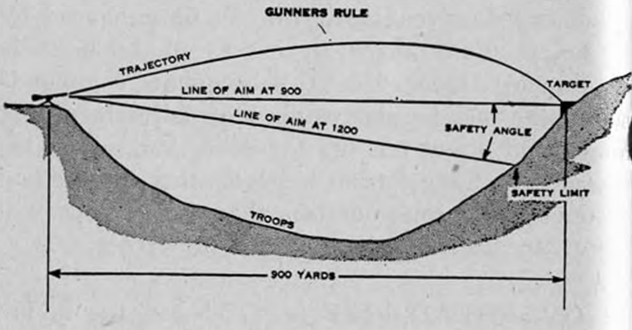

GUNNERS RULE
TRAJECTORY
LINE OF AIM AT 900
LINE OF AIM AT 1200
TARGET
SAFETY ANGLE
SAFETY LIMIT
TROOPS
900 YARDS

Figure 32. Application of gunner's rule.

. The above method will insure ample troop arance at all ranges up to 1,000 yards. It will not insure that troops will be far enough from the impact area to avoid shell fragments. Where a more accurate determination for closer support is desired, consult paragraph 165.

d. For determination of safety factors for ranges over 1,000 yards, computation of mask and troop clearances must be made by the method described in paragraph 157 or by use of table VII.

Section VII. FIRE COMMANDS

95. **GENERAL. a.** Fire commands are orders which convey all the information necessary for the commencement, conduct, suspension and cessation of fire, and activities incident thereto.

b. Fire commands must be given clearly, forcibly, and at a speed which may be received and applied without confusion. Much time is lost when a crew member has to ask for a repetition of part of the command. The use of standard commands eliminates misunderstanding.

96. **TYPES.** Direct fire commands are of two pes: initial fire commands and subsequent fire mands.

97. **INITIAL FIRE COMMANDS.** Initial fire commands for direct laying of the weapon must contain, where applicable, the elements listed below:

a. The alert.

b. Type of ammunition.

c. Fuze.
d. Direction.
e. Target description.
f. Range.
g. Leads.
h. Command to open fire.

98. ELEMENTS. a. The alert. The alert is alwa the first element of the initial fire command. consists of the command FIRE MISSION in t case of a stationary target, or the command MOVIN TARGET in the case of a moving target. The ale puts the gun crew in readiness to execute a fi command with the least practicable delay.

b. Types of ammunition. Ammunition is designated in the fire command as—

HE (High explosive)
HEAT (High explosive, antitank)
SMOKE (Smoke)
TP (Target practice)
INERT

This element is announced immediately after th alert. As soon as it is announced, No. four withdraws the proper type of ammunition from i individual container and prepares it for loading in the piece.

c. Fuze. The high explosive and target practi rounds have fuzes which may be set for superqui (SQ) or delay action. The rounds are originall packed so that the fuzes are set for superqui action. To obtain delayed action it is necessary specify DELAY in the fire command. If this ment is left out of the command the projectile ll be fired with the fuze set for superquick action. HEAT, SMOKE, and INERT rounds have no fuze settings. When using any of these types of ammunition, it is not necessary to mention the fuze element in the fire command.

d. Direction. Direction is generally given orally, or by pointing, or by a combination of these two methods. It is sometimes pointed out, in connection with target designation, by laying or firing the piece.

e. Target description. A target should be described as quickly and simply as is consistent with clarity. Where the target is obscure, it may be necessary to lead the gunner to the target by means of successive reference points.

f. Range. Range in yards, having been estimated or determined, is announced orally or signaled.

g. Leads. This element has application only in the case of moving targets. Leads are announced in numbers of five mil angular leads, as: THREE LEADS.

h. Command to open fire. This element is given as FIRE, or in the event a short delay becomes cessary, AT MY COMMAND, followed at the oper time by the command FIRE.

99. EXAMPLES OF INITIAL FIRE COMMANDS. a. (1) FIRE MISSION.

(2) HE.

(3) RIGHT FRONT.

(4) MACHINE GUN.
(5) SIX FIVE ZERO.
(6) FIRE.

b. (1) FIRE MISSION.
(2) HE.
(3) DELAY.
(4) LEFT FRONT.
(5) REFERENCE: HEDGE; RIGHT CORNER OF HEDGE, PINE TREE; BASE O PINE TREE, TARGET, MACHINE GUN.
(6) EIGHT HUNDRED.
(7) 3 ROUNDS, FIRE.

c. (1) MOVING TARGET.
(2) HEAT.
(3) TWELVE O'CLOCK.
(4) TANK.
(5) SEVEN HUNDRED.
(6) THREE LEADS.
(7) FIRE.

100. NUMBERS. Numbers are announced as illustrated below:

10	One zero.
25	Two five.
300	Three hundred.
1400	One four hundred.
6000	Six thousand.
3925	Three nine two five.
4050	Four zero five zero.

101. SUBSEQUENT FIRE COMMANDS. a. Subsequent fire commands contain only such data as are to be changed, except that the command for range and the command FIRE must be repeated each time. Corrections or changes in range are announced as ADD FIVE ZERO or DROP ONE ZERO. Changes in deflection are announced as RIGHT TWO FIVE or LEFT ONE ZERO. Changes in leads are announced as ONE MORE or ONE LESS.

b. In order to correct an error in the fire command, the person giving the command calls out CORRECTION, and immediately thereafter issues the corrected version.

Section VIII. RANGE CARDS

102. RANGE CARDS. a. A range card (fig. 33) is a diagrammatic or panoramic sketch showing the position of the gun, magnetic north, and ranges and azimuths to prominent terrain features and probable targets. By reference to ranges to nearby objects, it enables the gun crew to determine quickly and accurately the range to any target in the sector. The squad leader also can lay the gun for night firing on predetermined target positions, by using the tripod dial or aiming stake. If the members of the gun crew become casualties, the range card permits the replacement crew to deliver effective fire on likely targets.

b. Range cards may be constructed as follows:

(1) Place a dot in the approximate center of a

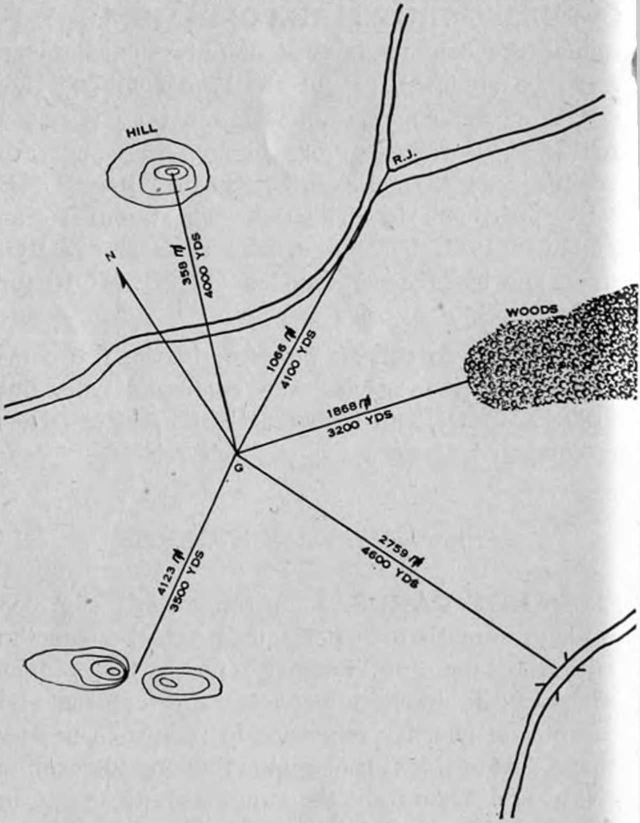

HILL
R.J.
N
358 ₥
4000 YDS
1066 ₥
4100 YDS
WOODS
1868 ₥
3200 YDS
G
4123 ₥
3500 YDS
2759 ₥
4600 YDS

Figure 33. Range card.

piece of blank paper to represent the position of the gun.

(2) Draw a straight line through the dot to represent magnetic north, and label the line.

(3) Determine the range and measure the azi-

uth in mils to prominent terrain features to be wn on the card.

(4) Using a protractor and a convenient scale, plot in the terrain features, labeling each.

(5) Draw straight lines from the gun position to the terrain features and label each line with range and azimuth.

Section IX. DIRECT LAYING ON LANDSCAPE TARGETS, 1000″

103. **SCOPE AND IMPORTANCE. a.** Upon satisfactory completion of the qualification course, the soldier may practice what he has learned by firing at landscape targets.

b. The advantages of landscape target firing are—

(1) It permits close supervision of all members of the firing unit.

(2) It clearly and quickly demonstrates the application and effect of fire.

(3) It can be conducted indoors when lack of facilities or weather conditions make this desirable.

(4) It emphasizes target designation and fire control.

104. **DESCRIPTION.** A landscape target is a panoramic picture of a landscape. It is so drawn that all or nearly all of the salient features are recognizable at a distance of 1000 inches. The standard target is the Series A target of five sheets in black and white.

105. PREPARATION OF TARGETS. a. Moun ing. The sheets are mounted on frames made c by 2 inch lumber. The frames are 24 by 60 inc and are covered with target cloth tacked to th edges.

b. Range indicators. To permit proper designatio of targets, assumed ranges must be used on lan scape targets. Small cards with appropriate num bers representing yards of range are tacked alon one or both edges of a series of panels (fig. 34 The gunner zeros his rifle at a given range, an must be cautioned that the range announced i any target designation is for the sole purpose o designating the target; the sight setting necessar to zero rifles must not be changed.

c. Direction cards. In order to provide the direc tion element in oral target designation, small card marked "front," "right front," "left front," "righ flank," "left flank" are tacked above the appropriat panels of the landscape series.

d. Scoring devices. (1) Scoring the exercise tend to create competition between individuals or sec tions and enables the instructor to grade thei relative proficiency. For a point target, a scorin device conforming in size to the 50 percent and 7 percent shot groups can be made from wire, cellu loid, plywood, or similar material (fig. 35). T scoring space can be outlined on the target pencil before the target is shown to the sectio leaders. This procedure prevents section leader from misunderstanding the limits of the designate target. Upon completion of firing, the entire sectio is shown the target and the results of the firing.

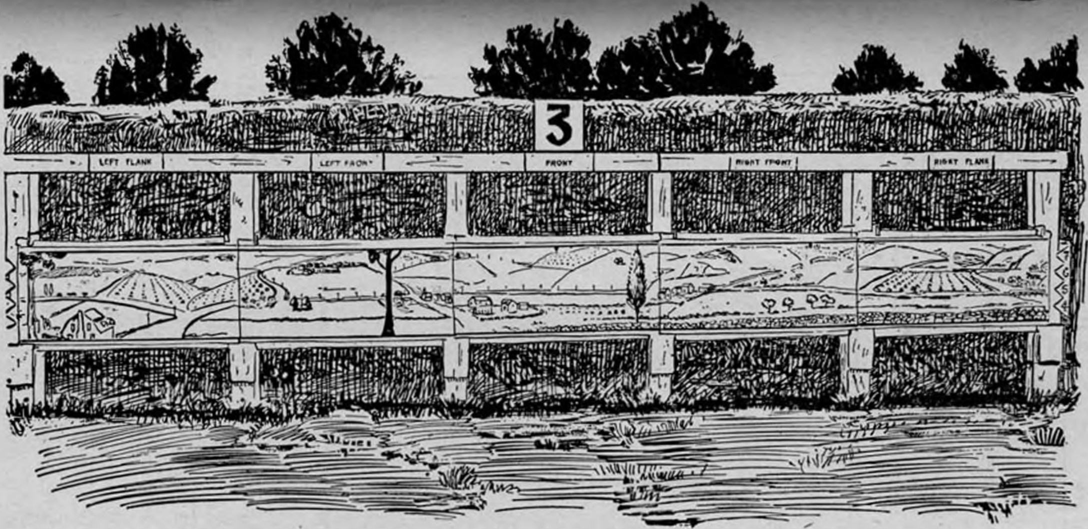

3
LEFT FLANK
LEFT FRONT
FRONT
RIGHT FRONT
RIGHT FLANK
7
6
5
4

Figure 34. Landscape target with range and direction indicators.

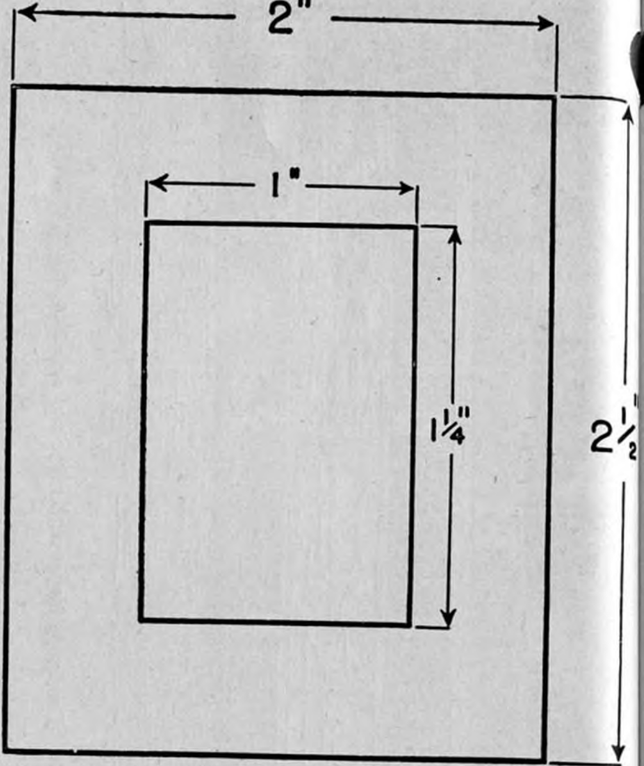


Figure 35. Scoring device 1000" range.

(2) Although shot groups take the form of a vertical ellipse, the 50 percent and 75 percent zones should be shown by the devices as rectangles. This is for convenience in their preparation. At 1,000 inches the 50 percent zone is a rectangle 1¼ inches high by 1 inch wide. The 75 percent zone is a rectangle 2½ inches high by 2 inches wide. The target is at the center of the inner rectangle or 50 percent zone.

106. ZEROING OF RIFLES. Rifles are zeroed in the same manner as outlined in paragraph 61**d**, using an assumed range of 700 yards. At a distance of 1,000 inches, changes of one mil elevation and windage, respectively, will move the strike of the bullet 1 inch in the desired direction.

107. FIRING PROCEDURE. The following sequence is used in conducting firing exercises:

a. All members of the section except the section leader face to the rear.

b. The instructor takes the section leader to the panels and points out the target to him. They return to the firing line, and the section leader takes charge of the section and orders the gunner and assistant gunner to resume their firing positions.

c. The section leader designates the target orally. Reference to panels to indicate direction should not be allowed in the designation. The section leader completes his fire command with the command, FIRE. Each gunner is allowed 10 rounds.

d. When the gunner has completed firing, the section leader commands: CEASE FIRING, CLEAR RIFLE. He checks to see that this is done. The target is then examined and scored.

e. The instructor holds a short critique after each exercise.

f. For section competition, each member of the section is given a target; his score is computed and added to the score of other members of the squad. Combined individual scores indicate the score for the section.

108. SCORING. The sum of the value of the hits within the two zones is the score for the exercise. For convenience of scoring and comparison, 100 is fixed as the maximum score. Any method of scoring and of distribution of ammunition among members of the section may be used. For example:

a. Number of rounds fired, 50.

b. Value of each hit in 50 percent zone, 2.

c. Value of each hit in the area of the 75 percent zone outside the 50 percent zone, 1.

109. EXERCISES. a. Number 1. (1) *Purpose.* To teach target designation and to show the effect of concentrated fire.

(2) *Method.* The platoon (section) leader directs the fire of his platoon (section) at a point target indicated to him by the instructor.

b. Number 2. (1) *Purpose.* To teach target designation and the division of the platoon (section) fire between two points.

(2) *Method.* The instructor indicates two point targets to the platoon (section) leader, giving the nature of each. The platoon (section) leader applies the fire of his platoon (section) on the two targets in proportions indicated by the nature of each. The scoring will be as for concentrated fire on each target, the two scores being combined in total for the score of the exercise.

c. Number 3. (1) *Purpose.* To teach target designation and fire control in diverting part of the fire of the platoon (or section with 2 guns in action) to a suddenly appearing target.

(2) *Method.* The instructor indicates a target to [illegible]e platoon (section) leader. The platoon (section) leader applies the fire of one or more guns to this target. After firing has commenced, the instructor indicates and gives the nature of a point target to the flank. He then directs the platoon (section) leader to shift one or more guns from the first to the second target. The method of scoring is to add the value of hits on both targets.

Section X. TRANSITION FIRING

110. **PURPOSE AND SCOPE.** This phase of training gives the individual gunner practice in searching areas, estimating ranges, and firing rapidly and accurately. It emphasizes the necessity for continued application of the principles stressed in earlier marksmanship training, and prepares him for field firing exercises which follow later.

111. **RANGES, PERSONNEL, AND PROCEDURE. a. Ranges.** The ranges are constructed to provide targets as outlined in the firing table below. For protection of the pit detail, individual open pits of the foxhole type should be used. To [illegible]ntrol the raising and lowering of targets, com[illegible]nication between the firing points and pits is necessary. Targets are fastened to poles of sufficient length to permit exposure of the target from the pit without endangering the personnel in the pits. The number of lanes constructed will depend upon the number of persons to fire.

b. **Personnel.** One officer is required at each firing point to control the firing. Pit details w consist of one or two men per target, with telephone orderly at the firing point to transmi scores and orders for control of targets.

c. Procedure. After the command LOAD, th officer in charge of firing gives the signal for th raising of targets. Unless hit, all targets remai up until the signal to withdraw them is give When all targets are withdrawn the target operato scores the targets and reports the score to th firing line. A coach at each firing point record the score. Since a hit is indicated by the lowerin of the target, no extra credit is given for more tha one hit on a target. However, if two targets ar hit by one bullet, both targets are scored.

112. FIRING TABLE. Firing will be conducte in accordance with table VI.

Table VI. Firing Table

No. of rounds	*Type target*	*Range*	*Maximum score*
3......	Prone "F" M–1917 complete.	unknown (0–200 yards)	5
3......	Prone "F" M–1917 complete.	unknown (0–300 yards)	5
3......	Kneeling "E" M–1917 complete.	unknown (300–500 yards)	5
3......	Kneeling "E" M–1917 complete.	unknown (300–500 yards)	5
			20
	Score for rounds not fired—		8
	Possible score		28

a. Carbine tracer ammunition will be used.

b. Time allowance, 3 minutes for entire table.

c. Gunner will be allowed 3 rounds to hit each target. If he does not get a hit in 3 rounds, he proceeds to the next target. He will be scored 5 points for each target hit and will be given a credit of one point for each round not fired per target, providing the target is hit. No credit will be given for rounds not expended per target if the target is not hit. It is not necessary that all targets be hit to receive credit for unexpended rounds on targets that were hit with less than 3 rounds.

d. Target scoring will be done by operators in pits.

e. Fifteen points is a satisfactory score for this exercise.

Section XI. FIELD FIRING

113. PURPOSE AND SCOPE. The purpose of field firing is to demonstrate individual and crew proficiency in all phases of combat for the section and platoon. The unit is conducted through a series of exercises which, as nearly as possible, simulate battlefield conditions. The situation for each exercise will be given by the instructor who will act as umpire. The tactical commanders will direct and control their units in the actions required. At the completion of each exercise, a critique will be held by the umpire.

114. EXERCISES. The terrain should be varied for each exercise, if possible, so that the unit will be presented with a new situation for each exercise. The following exercises are given as guides for the preparation of such training.

a. No. 1 (direct fire). (1) *Purpose. (a) For the section leaders.* Practice in control of their units in order to engage properly various types of targets.

(b) For the members of the section. Application of the factors which govern the selection of positions, the use of individual cover and concealment ammunition supply, and technique of fire.

(2) *Unit.* One section.

(3) *Situation.* The section is located in an assembly area and is issued ammunition. The section leader is given pertinent portions of an operation order, to include position areas, target areas and sectors of fire, and the location of friendly troops.

(4) *Method. (a)* The section leader selects his route of approach, his gun position, and issues the necessary orders to place the gun in position. When a target is indicated, the section leader issues his fire command, opens fire, and adjusts his fire. Fire for effect is not a part of these exercises. As soon as the fire has been adjusted, the duties of the crew are rotated and a new target is designated. The section leader must be prepared at any time to displace forward, move to an alternate position, or withdraw to a covered area. Selection of the proper type of ammunition will be the responsibility of the section leader.

(*b*) Some possible types of targets are—

1. Camouflaged cave type fortification with natural camouflage. Cave opening to be 2 feet by 1 foot. Range 400–600 yards.

2. Mock tank or tank chassis. Range 600–800 yards.
3. Camouflaged log and earth pill-box. Range 800–1000 yards.
4. Pill box requiring section leader to smoke the apertures. Range 400–500 yards.

b. No. 2 (indirect fire). (1) *Purpose. (a) For the leaders.* Reconnaissance and selection of positions, routes of approach, observation posts, and control of units.

(*b*) *For the members of the unit.* Same as exercise No. 1.

(2) *Unit.* 75-mm rifle platoon.

(3) *Situation.* The unit is located in an assembly area and is issued ammunition. The section leader is given pertinent portions of an operation order, to include position areas, target areas, sectors of fire, and the location of friendly troops.

(4) *Method.* (*a*) The unit leader proceeds in the same manner as that outlined in exercise No. 1; however, the situation should be presented so that indirect fire is indicated.

(*b*) The targets selected for this exercise should be of such a nature that point target or limited area fire is clearly indicated.

115. AMMUNITION. The exercises are designed for service ammunition; however, where range facilities are limited, subcaliber ammunition may be used. Where subcaliber ammunition is used, the section leader should be required to specify what type of ammunition he would use were he firing service ammunition. Also when subcaliber ammunition is used, the ranges of targets suggested in paragraph 114**a** (4) (*b*) must be modified to less than 500 yards in order to observe the tracer strike.

116. CRITIQUE. At the completion of each exercise the instructor should conduct a critique covering the following points (care should be taken by the officer conducting the critique to avoid confusing effectiveness of fire with over-all unit performance):

a. Reconnaissance.
b. Actions and orders of unit leaders.
c. Suitability of observation posts.
d. Suitability of firing positions.
e. Suitability of alternate positions.
f. Use of cover and concealment.
g. Technique of fire.
h. Ammunition resupply plans.
i. Proper employment of types of ammunition.

CHAPTER 6

TECHNIQUE OF INDIRECT FIRE

Section I. GENERAL

117. PURPOSE AND SCOPE. Although the 75-mm rifle was designed primarily as a direct fire weapon and will normally function in this role, occasions may arise which indicate the desirability of using the weapon in partial or complete defilade. This chapter discusses the means by which such fire is effected. For more detailed description of this subject matter see FM 6–40.

118. ORGANIZATION FOR INDIRECT FIRE. Except in position defilade firing, in which case the observer issues commands direct to the gunners, organization for indirect fire normally consists of—

a. An observer who sends back corrections in yards to the battery. The observer is usually the platoon leader or platoon sergeant, although anyone trained in observation methods may act in his capacity.

b. A fire direction center which translates the observer's corrections into fire commands and issues them to the gunners. The fire direction center is usually made up of one or both section leaders and a radio or telephone operator.

Section II. COMPUTATION OF INITIAL DATA

119. PREPARATION OF DATA. Normally the observer designates the location of the target by one of the means outlined in paragraph 132. The fire direction center then prepares the initial data for laying the guns. However, at times it may be necessary for the observer to prepare his initial data. When initial data are determined by the observer, he must send them to the gun position in the form of fire commands (see par. 155).

120. TERMINOLOGY. The definitions, abbreviations, and terms listed below are used in the preparation of firing data.

a. Direct laying. The piece is laid by sighting on the target.

b. Indirect laying. The piece is laid by sighting on a point other than the target.

c. Firing angle (A). The clockwise horizontal angle from the target to the aiming point (see fig. 36).

d. Deflection. The setting of the sight which corresponds to the firing angle. An increase of deflection moves the plane of fire to the left, a decrease moves it to the right.

e. Measured angle (M). The horizontal angle (vertex at the observation post) from the target to an aiming point, base point, or other points (fig. 36).

f. Target offset (T). The horizontal angle (vertex at the target) between the piece and the observation post (fig. 36).

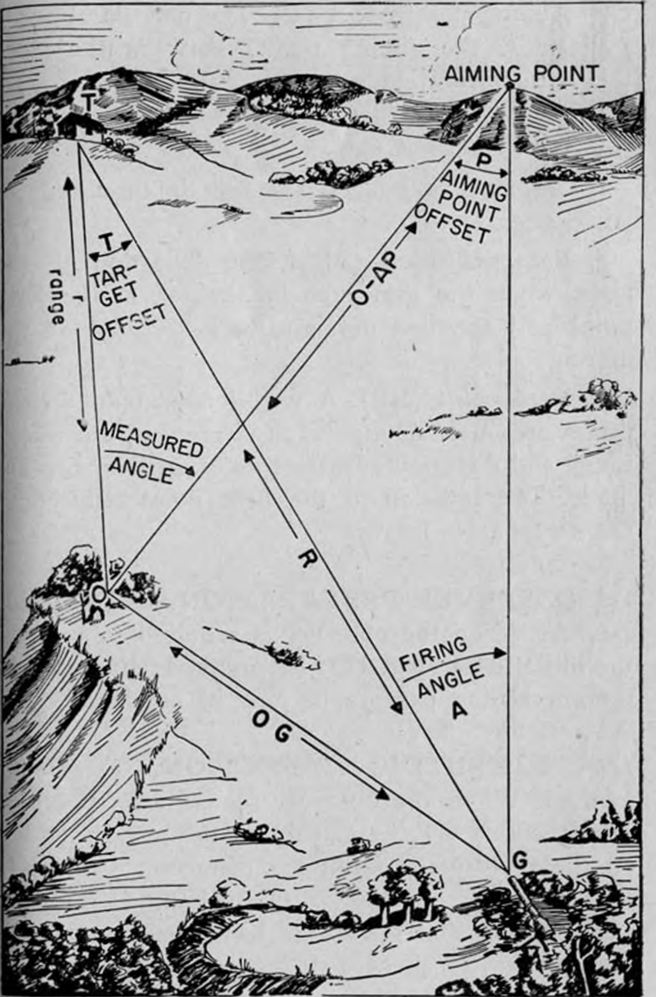

AIMING POINT
T
P
AIMING POINT OFFSET
O-AP
T
TAR-GET OFFSET
r
range
MEASURED ANGLE
R
O
FIRING ANGLE
A
OG
G

Figure 36. Terms used in preparation of fire.

g. Aiming point offset (P). The horizontal angle (vertex at the aiming point) between the piece and the observation post (fig. 36).

h. Range (R). Distance in thousands of yards from G to T.

i. Observed range (r). Distance in thousands of yards from O to T.

j. Base deflection (BD). The deflection on the sight when the gun tube is directed at the base point and the line of sighting is directed at the aiming point.

k. Base point (BP). A well-defined point in the target area used as a point of reference from which range and direction adjustments of artillery fire are made. The location of the base point relative to the weapons is known.

121. OBSERVER PREPARATION OF INITIAL DATA. When the observer is required to prepare the initial data (par. 119) the methods discussed in the succeeding paragraphs may be employed.

122. COMPUTING DIRECTION. a. Hasty method. When the observer selects an OP on or near the line GT, he can direct the gunner to lay on the OP by the following command: AIMING POINT, OP, DEFLECTION ZERO, LAY ON ME. When this operation has been completed, the gun will be pointed in the general direction of fire.

b. Alidade method (fig. 37). The observer sights on the gun with an alidade consisting of a pencil

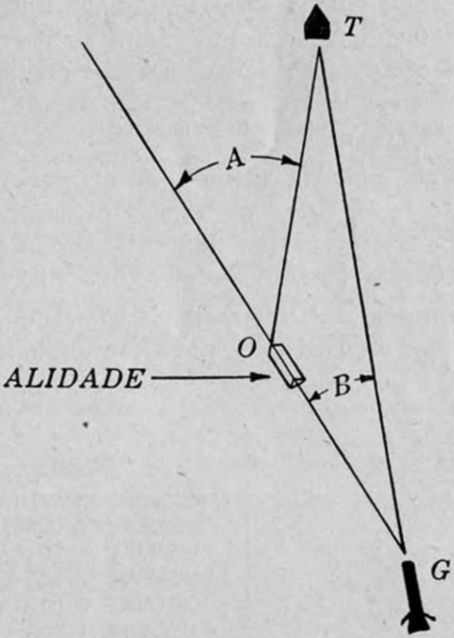


Figure 37. Alidade method of determining initial direction.

or a straight edge. Without altering the position of the alidade, he measures the deviation (A) between the direction to the target and the direction in which the alidade points. He multiplies this deviation by the deflection correction factor r/R to obtain the approximate value of angle B. He then commands, AIMING POINT, OP; DEFLECTION RIGHT (LEFT)————; LAY ON ME.

c. Parallel line method. The observer estimates the shortest distance from the observation post to the line GT. He selects an object on the ground to the front, on the same side of the line GT and at the same distance from this line as he is located. With a compass he determines the magnetic azimuth of the selected object. This is the azimuth of the line GT.

d. Rapid plotting method. A diagram may be drawn to scale, either on a sheet of paper or on a map or overlay. From this diagram range and deflection may be read directly (fig. 38).

e. Compass and mil method. The compass and mil method is used only when the angle T is less

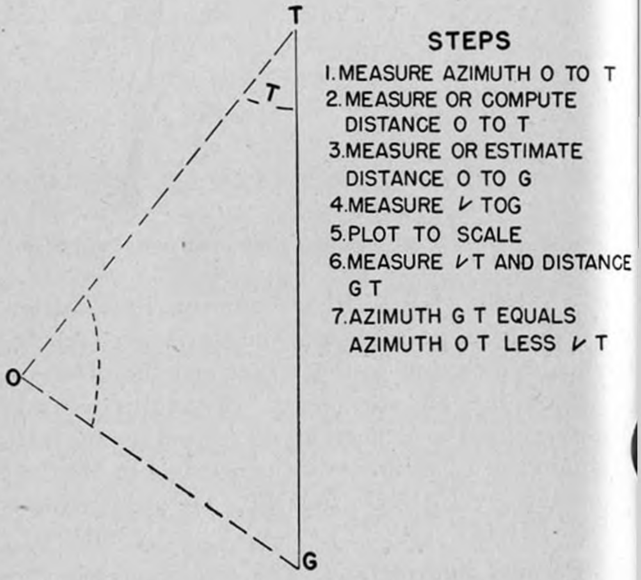

T
T
O
G
STEPS
1. MEASURE AZIMUTH O TO T
2. MEASURE OR COMPUTE DISTANCE O TO T
3. MEASURE OR ESTIMATE DISTANCE O TO G
4. MEASURE ∠ TOG
5. PLOT TO SCALE
6. MEASURE ∠T AND DISTANCE G T
7. AZIMUTH G T EQUALS AZIMUTH O T LESS ∠ T

Figure 38. Rapid plotting diagram.

than 400 mils. The observer at the observation post proceeds as follows:

(1) Reads the azimuth of the line OT.

(2) Estimates the distance OT and at the same time estimates the shortest distance from his position to the line GT.

(3) Using the mil formula, he finds the angle T and adds or subtracts it from the azimuth OT. If the gun is on the left of the observer, he adds; if the gun is on the right, he subtracts. The result is the azimuth on which the gun should be laid.

Note. A convenient method for teaching observers to know quickly whether angle T should be added or subtracted is to use the word "GLARS" (gun left, add; right, subtract).

Example (gun right of observer):

Azimuth OT	1,800 mils.
Range OT	1,500 yards.
Shortest distance from O to line GT	300 yards.

$$\frac{300}{1.5} = 200 \text{ mils} = \text{angle T}$$

Determine the azimuth of the line GT by subtracting 200 mils from 1800 mils.

The azimuth GT is 1600 mils.

f. M–10 plotting board. Direction, range, and angle of site can all be determined using the M–10 plotting board. (For operation see paragraph 28 and FM 23–55.)

123. COMPUTING ANGLE OF SITE. When approximate initial firing data are used, the angle of site may be estimated, or may be assumed to be zero. However, when more accurate computation is desired, the observer may employ a contoured map, an M–10 plotting board, or may compute it by the use of an instrument, such as the aiming circle and application of the mil relation formula. In this latter method, the observer computes the difference in elevation between the OP and the gun, the OP and the target, and thus between the gun and target. With this difference in elevation he can find the angle of site of the line GT.

124. ELEVATION. (a.) The range GT is determined from maps, by estimation, from friendly troops, by rapid plotting, or from the M–10 plotting board. The angle of elevation for this range is found in the firing tables.

b. The angle of site and the elevation for the range are added together algebraically and the resulting quantity is known as the quadrant elevation. The quadrant elevation is placed on the sight or the gunner's quadrant.

Section III. GENERAL PRINCIPALS OF CONDUCT OF FIRE

125. GENERAL. This section is concerned with the computation of factors, initial fire requests, and general principles of observer conduct of fire. The fundamental principle underlying observer conduct of an adjustment is that all bursts should remain on or near the OT line. For this purpose two procedures are employed. These are the range-bracketing and the deflection-bracketing procedures, each of which will be discussed in later sections of this chapter.

126. SENSINGS. One positive sensing is sufficient to establish a limit of a bracket. Sensing must be made promptly, except when it is necessary to take advantage of drifting smoke. Sensing must be based on what the observer sees while it is before his eyes, not on what he recollects. Except for terrain sensings, range or deflection sensings on bursts wide of the target should be made with caution. When sensings are made on drifting smoke or on shadows, the direction of the wind and the position of the sun must be considered.

127. BRACKETING. It is better to overestimate the necessary corrections than to underestimate them, because in this way a bracket is more readily obtained. The controlling element is that element (either range or deflection) which is more difficult to sense. Range is the controlling element in range bracketing procedure (target offset of 500 mils or less) and deflection is the controlling element in deflection bracketing procedure (target offset greater than 500 mils).

128. KEEPING BURSTS ON LINE. **a.** If a range change is made from a line shot, a corresponding deflection change is necessary to keep the burst on the OT line; conversely, if a deflection change is made from a line shot, a corresponding range change is required. S is the deflection shift *in yards* which keeps the burst on the OT line when the range is changed 100 yards (fig. 39).

b. When sensings are obtained, small deviations which might be caused by dispersion or by minor

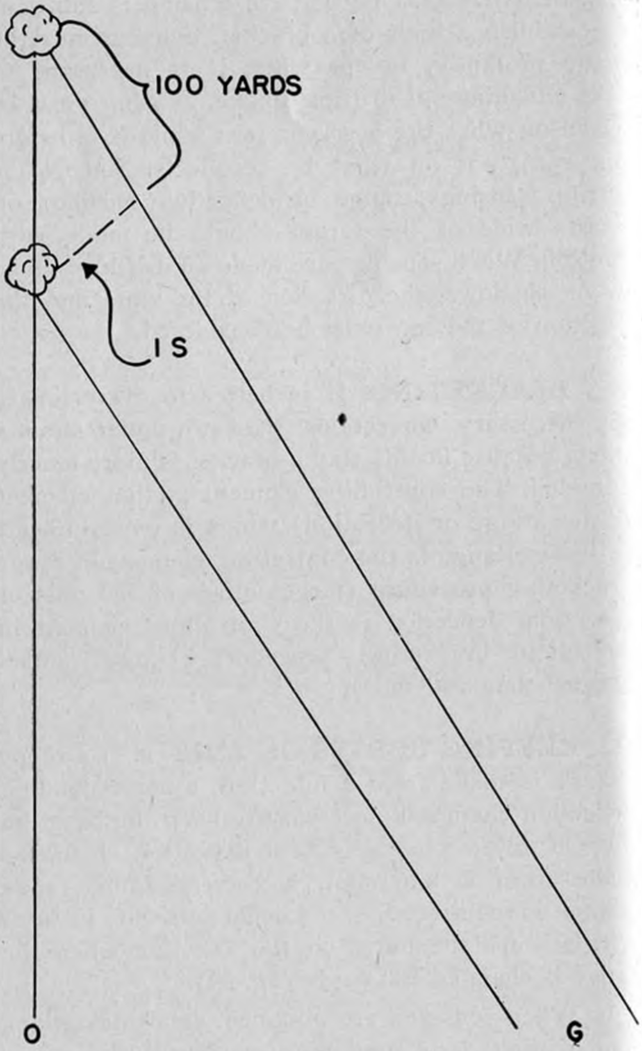

100 YARDS
1 S
O
G

Figure 39. The factor "S".

irregularities of the ground are ignored. Larger deviations which might hamper future sensings are corrected to place bursts on the OT line.

129. DETERMINATION OF DEFLECTION FACTOR "S". The deflection factor "S", in yards, may be determined by—

a. Estimation and subsequent correction by firing.

b. Computation using the formula S = 1/10 T (if T is less than 600 mils).

c. Use of ranging rounds.

130. EMPLOYMENT OF RANGING ROUNDS. **a.** Ranging rounds consist of two rounds fired as rapidly as possible from the adjusting piece, the first round where ordered by the observer, and the second round at a range 400 yards greater. The observer proceeds as follows:

(1) He notes the line established by the two ranging rounds and visualizes the gun-target line.

(2) He measures the deviation (in mils) between bursts and converts this deviation (fig. 40) to yards by means of the mil relation formula. Example:

Estimated range to 1st burst......1,500 yards.
Measured deviation in mils.......100
Deviation in yards..............W
W = RM = 1.5 x 100 = 150 yards.

(3) If the observed deviation is 200 yards or less the observer divides it by 4 (the distance between ranging rounds in hundreds of yards) to obtain the S factor.

(4) If the observed deviation is greater than 200 yards, the value of S is no longer equal to approximately one-fourth the value of the observed deviation. Instead, the observer uses the following table of approximate values in order to obtain a usable S.

For an observed deviation of— (*yards*)	*Use an S of—* (*yards*)
250	80
300	100
350	200

For larger values of S a precise determination is not required.

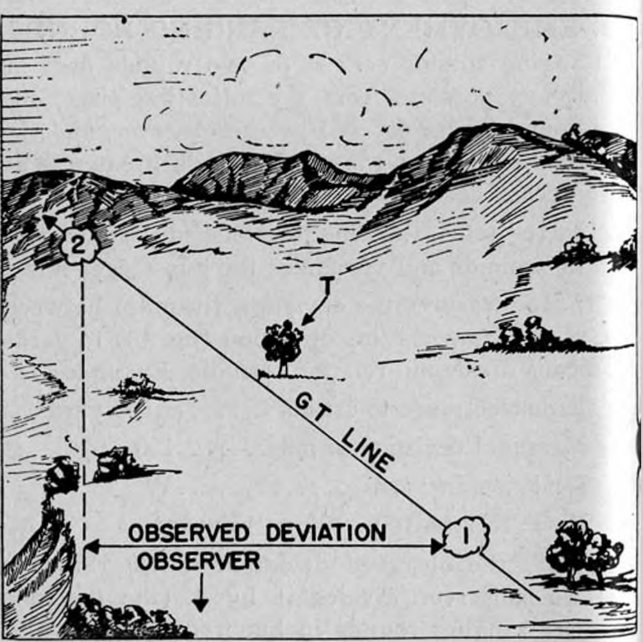


Figure 40. Observed deviation in ranging rounds.

(5) If the observed deviation between ranging rounds is 200 yards or less, range is the controlling element, and the observer uses range bracketing procedure. If the observed deviation is greater than 200 yards, deflection is the controlling element and the observer uses deflection bracketing procedure.

b. When the observer desires ranging rounds fired, he includes in his initial fire message FIRE RANGING ROUNDS. Corrections are based on the first of the two ranging rounds.

131. CORRECTIONS AND TERMS. Listed below are corrections and terms normally used by the observer. Any additional information that would assist in bringing desired fire on the target may be transmitted.

a. **Left (Right) (so many yards).** To correct the deflection.

b. **Converged (so many yards) sheaf.** To obtain a converged sheaf (or a sheaf of any desired width).

c. **Converge on No. two (or other piece).** To obtain a sheaf converged on the desired piece.

d. **Up (Down) (so many yards).** To correct for differences in altitude in the target area in the initial fire message.

e. **Add (Drop) (so many yards).** To increase (decrease) the range.

f. **Repeat range.** To obtain fire with no change in any element of the firing date.

g. **Salvo right (left).** To obtain battery salvos beginning with the right (left) piece.

h. Fire for effect. To indicate that the adjustment is satisfactory and that the unit is to fire fo effect.

i. Special corrections. To indicate that individual corrections for lateral distribution and variations in range between pieces is necessary.

j. Correction. A term used in a fire message to indicate that an error in data has been announced and that corrected data will follow; any change in firing data to bring the center of impact or burst closer to the target.

k. Lost (followed by correction to obtain observation). To indicate that the last round or volley was not observed.

l. Cease firing, end of mission. To terminate firing on a target.

m. Cease firing. To interrupt firing for any reason.

132. INITIAL FIRE REQUEST. The initial fire request sent by the observer to the fire direction center includes the following elements in the sequence indicated:

Identification of the observer.
Warning order.
Location of target.
Nature of target.
Type of adjustment.
Type of ammunition.
Control.

a. Identification of the observer. The observer, when necessary, identifies himself, usually by use a code word.

b. **Warning order.** The observer sends FIRE MISSION to alert the fire direction center.

c. **Location of target.** The location of the target may be given in one of the following ways:

(1) By giving a shift in yards from a point, the location of which is known by the fire direction center (fig. 41). The shift is given in the sequence:

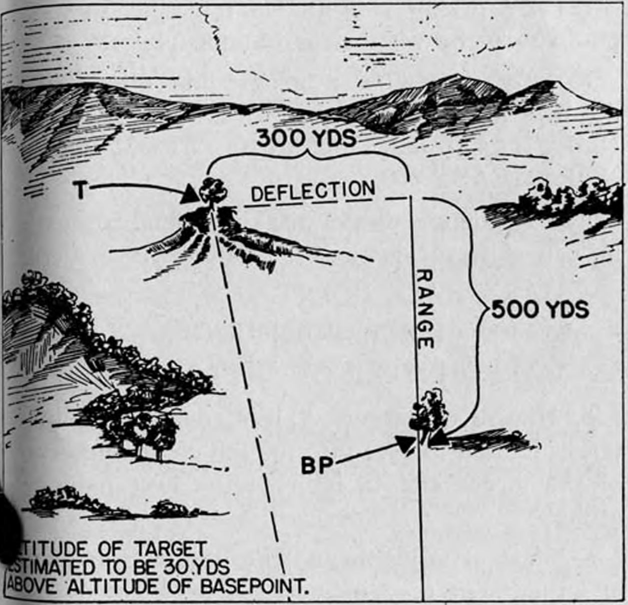

300 YDS
T
DEFLECTION
RANGE
500 YDS
BP
TITUDE OF TARGET
STIMATED TO BE 30 YDS
ABOVE ALTITUDE OF BASEPOINT.

Figure 41. Designating the location of the target with respect to a known point. The observer sent to FDC: FROM BASE POINT, LEFT 400, UP 30, ADD 600 (to assure bracketing the target between the known point and the initial round.)

Known point, deflection, altitude, range. For e ample: FROM BASE POINT, LEFT FOU HUNDRED, UP THREE ZERO, ADD S HUNDRED. The deflection and range correctio should be large enough to assure the bracketing the target between the known point and the initi round. Normally the altitude element is omitte However, where differences in altitude between th known point and target would cause a large chang in angle of site, this element is included.

(2) By giving coordinates referring to a ma photo map, or vertical or oblique photo.

(3) By means of a geographic direction an distance from a known point, as: FROM CR 22 NORTH 400, EAST 500; or FROM CR 93 NORTHEAST 600.

(4) By commanding a marking round from whic he can shift to his target. Examples:

MARK BASE POINT.

MARK CHECK POINT NO. 3.

MARK CENTER OF SECTOR.

d. **Nature of target.** A brief description of th target is used to give information of the importanc of the target and to indicate the best manner o attack.

e. **Type of adjustment.** The designation of typ of adjustment may include special sheaf or rang spread desired, or any other special requiremen If salvo fire is desired, the observer sends SALV RIGHT (LEFT). If no specific type of fire i designated, single gun adjustment will be use

Adjustment by single gun will be the normal ethod.

f. **Types of ammunition.** The observer designates the type of projectile and fuze desired. **Choice of** projectile and fuze depends on type of target and effect sought. If no specific types of ammunition are designated, He with fuze superquick will be used.

g. **Control.** The observer's designation of control will consist of one of the following:

(1) *WILL ADJUST*. This indicates that the accuracy of the observer's location of the target is such that an adjustment is considered necessary and that the observer can adjust fire. If observation is difficult or intermittent, the observer precedes WILL ADJUST by AT MY COMMAND. In this event, the observer transmits FIRE after receipt of READY from the fire direction center, and when he is in a position to observe. This procedure remains in effect until a subsequent correction is followed by the command WHEN READY.

(2) *FIRE FOR EFFECT*. When transmitted as part of the initial fire message, this indicates that the observer considers his location of the target be accurate, no adjustment necessary, and surise fire desirable. He observes the initial fire for effect and, if necessary, sends appropriate corrections to increase the effect of subsequent fire on the target.

(3) *CANNOT OBSERVE*. This indicates that the observer will be unable to adjust the fire.

h. Examples of initial fire messages:

(1) FIRE MISSION
MARK BASE POINT
TROOPS
WILL ADJUST

(2) FIRE MISSION
FROM BASE POINT
RIGHT FOUR HUNDRED
UP FIVE ZERO
ADD SIX HUNDRED
THREE MACHINE GUNS
WILL ADJUST

(3) FOX OBOE BAKER
FIRE MISSION
JIG MIKE 9763
INFANTRY IN FOXHOLES
HE FUZE DELAY
AT MY COMMAND
WILL ADJUST

(4) FIRE MISSION
(42.7–93.6)
INFANTRY IN OPEN
HE FUZE DELAY
FIRE FOR EFFECT

133. INFORMATION SENT TO OBSERVER. a
If a target is to be fired upon, the fire directio
center furnishes the following information to th
observer:

	Example
(1) Adjusting piece	No. 3
(2) Projectile and fuze	HE DELAY
(3) Concentration No. assigned.	CONCENTRATION NO. 30
(4) Time of opening fire	WHEN READY

b. If the mission cannot be fired, the observer is notified WILL NOT FIRE, along with the reason for not firing.

c. The observer is informed ON THE WAY as each round is fired during adjustment. He is notified when fire for effect has been completed; for example, ROUNDS COMPLETE.

134. SUBSEQUENT CORRECTIONS. a. Any element of subsequent corrections, other than the correction for range, may be omitted if no change in that element is desired. If some element is to be corrected, but range is not, the observer sends the correction for that element followed by REPEAT RANGE. If it is desired to fire with the same data as the last rounds, the observer sends REPEAT RANGE.

b. Subsequent corrections are given in the following sequence:

(1) Deflection correction.

(2) Distribution correction.

(3) Change in any special requirements (for example, to change from single gun to salvo fire, or from salvo to volley fire).

(4) Change in number of rounds to be fired.

(5) Change in ammunition (for example, to change from fuze superquick to fuze delay).

(6) Range correction.

135. CORRECTION OF ERRORS. If the observer has transmitted his initial fire request and finds that he has made an error in one of the elements contained therein, he sends CORRECTION followed only by the information pertaining to the element which is in error. If an element is omitted, the observer sends that element to the fire direction center as a separate transmission.

Section IV. CONDUCT OF FIRE BY RANGE-BRACKETING PROCEDURE

136. GENERAL. Range-bracketing procedure is employed when the observed deviation between ranging rounds is 200 yards or less.

137. RANGE BOUNDS. After a round has been sensed positively, the first range bound is made large enough to bracket the target. Initial range changes are made in hundreds of yards. Normally, when firing at observed ranges over 2,000 yards, the initial range correction should not be less than 400 yards to establish the bracket.

138. ADJUSTMENT. a. The object of adjustment is to enclose the target within a range bracket of suitable depth, with deflection correct, or to obtain target hits. This is accomplished by successively splitting the initial bracket. Fire for effect is not enerally called for until a bracket of 100 yards or less is split.

b. **Ranging rounds.** The observer may order the firing of ranging rounds to assist in the computation of the S and to determine the type of bracketing to be employed.

c. **To get on the line.** When a burst cannot be sensed positively for range because of its deviation from the OT line, the amount of the deviation is determined, in yards, and a deflection correction, equal to that amount is made to place the next burst on the OT line..

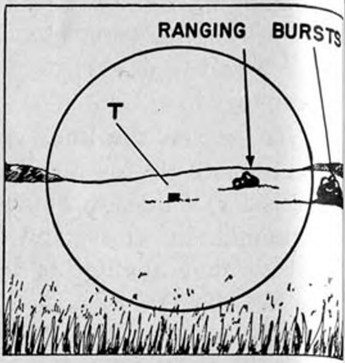
d. **To stay on the line.** When a line shot is obtained, shift of one S is made for each 100-yard change in range in order to keep the burst on the OT line. When a burst off the OT line is sensed positively for range, the observer's deflection correction combines a shift to bring the Off line burst to the line, and a shift to stay on the line when the range is changed.

139. FIRE FOR EFFECT. a. Starting fire for effect. Fire for effect is started when a suitable bracket is split, a target hit is obtained, or a salvo brackets the target for range. If all pieces of the attery are calibrated (par. 156) they may be brought into fire for effect when the base piece has been adjusted. If they have not been calibrated, it is advisable to adjust the other guns by means of battery salvos before commencing fire for effect. If fire for effect was accurate but insufficient the observer may command REPEAT RANGE,

REPEAT FIRE FOR EFFECT. The observer ca
and should make corrections while fire for effect
being delivered.

Observer to FDC (initial fire request):
FIRE MISSION,
MARK BASE POINT,
FIRE RANGING ROUNDS,
WILL ADJUST.

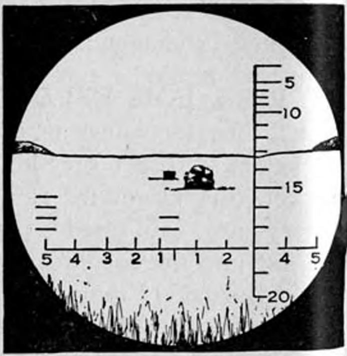
FDC to Observer:
RANGING ROUNDS,
FUZE QUICK,
BASE POINT,
WHEN READY . . . .
ON THE WAY.



Remarks: *OT* distance from map = 2,000 yards. With field glasses, observer measures 40 mils between ranging rounds. Observed deviation = 80 yards (40 x 2). *S* = 20 yards (80/4). Guns to right rear. Range-bracketing to be used. No range sensing obtained. First ranging round is 80 mils right of *OT* line. Observer determines shift of 160 yards (80 x 2) necessary to bring burst to *OT* line.

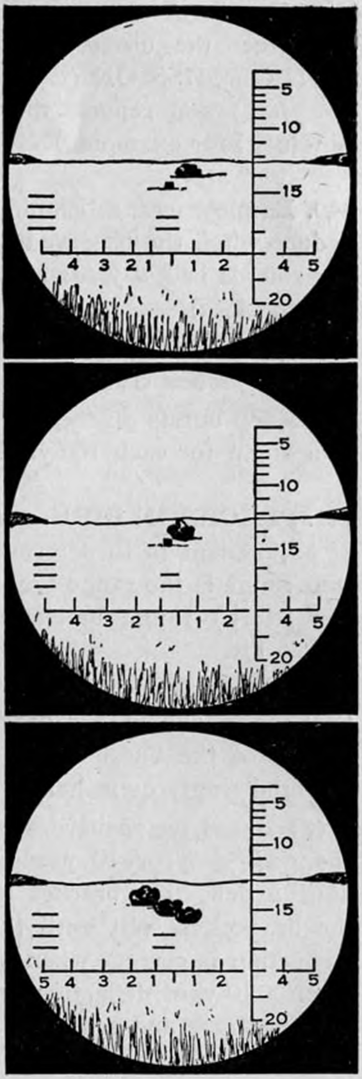
Observer to FDC:
LEFT 160,
REPEAT RANGE.

FDC to Observer:
ON THE WAY



Remarks: Small deviation is ignored. Observer decides that 200-yard range change should give a range bracket.

Figure 42. Illustrative examples.


5
10
15
20
4 3 2 1 1 2 4 5
5 4 3 2 1 1 2 4 5

Observer to FDC:

RIGHT 40
ADD 200.

FDC to Observer:

ON THE WAY

Observer to FDC:

LEFT 20,
DROP 100

FDC to Observer:

ON THE WAY

Observer to FDC:

LEFT 10,
3 ROUNDS
DROP 50.
FIRE FOR EFFECT

Observer to FDC:

CEASE FIRING,
END OF MISSION

Figure 42. Illustrative examples—Continued

b. Report of observer. Upon completion of fire for effect the observer sends CEASE FIRING END OF MISSION (if fire has been effective and sufficient) and reports the effect which has been obtained; for example, INFANTRY DISPERSED.

140. Employment. a. Employ range-bracketing procedure when the observed deviation between ranging rounds is *200 yards or less* (target offset of 500 mils or less).

b. Bring bursts to the *OT* line by making appropriate *deflection* corrections.

c. Keep bursts on the OT line by shifting deflection one *S* for each 100-yard range change.

141. PRECISION FIRE. a. Adjustment. The object of adjustment is to determine the *trial range*. The trial range is the range for the center of a 100-yard (or 1-fork) range bracket, or a range giving a target hit.

b. Fire for effect. (1) Start fire for effect at the trial range, and with a deflection correction which will place the burst on the OT line. The rounds are fired singly or in half-groups of three.

(2) Based on positive sensings, the deflection is changed ½ *S* or 10 yards, whichever is greater, until a deflection bracket is obtained. Thereafter, the bracket is split until the deflection is correct. Deflection is correct when a target hit is obtained, when a 10-yard deflection bracket is split, or when *deflection over* and *deflection short* are obtained with the same deflection setting.

(3) Obtain and report to the fire-direction center a group of six usable range sensings.

c. Types of registration. (1) *SIX ROUND REGISTRATION.* This is the type normally used. The adjusted elevation is computed by fire-direction center as follows:

(*a*) If the first three rounds fired for effect are all in the same sense and the observer has made the appropriate range change and has fired three more rounds, all six rounds are considered to have been fired at the mean of the two elevation used.

(*b*) With an equal number of *overs* and *shorts,* the adjusted elevation is the elevation at which the group was fired.

(*c*) With unequal numbers of *overs* and *shorts,* the difference between the number of *overs* and *shorts* (neglecting target hits) is determined. Apply the formula:

$$\left(\frac{\textit{Difference in number of overs and shorts}}{2 \text{ X number of rounds fired}}\right) \text{ X F},$$

and add (subtract) the result to (from) the elevation used (or mean elevation).

Note. If there were more *overs* than *shorts,* subtract; if there were more *shorts* than *overs,* add.

(*d*) Adjusted elevation is taken to the nearest mil. The fork used for the computation corresponds to the elevation at which the group was fired.

Section V. CONDUCT OF FIRE BY DEFLECTION-BRACKETING PROCEDURE

142. DEFLECTION. When the observer is considerably to one side of the GT line, he can determine the range error more accurately than he can the deflection error. Deflection, therefore, becomes the controlling factor and the observer will use the deflection-bracketing procedure described below for adjusting on the target. This procedure is employed when the observed deviation between ranging rounds is greater than 200 yards.

143. DEFLECTION BOUNDS. After a round has been sensed positively, the first deflection bound is made large enough to bracket the target. That is, a bold enough change is made for the second round to insure that a bracket is established. Normally a deflection correction for the initial bracket should not be less than two S's, or greater than 400 yards.

144. COMPUTATION OF RANGE FACTOR (d). **a.** In deflection bracketing, bursts are brought to the OT line by range changes. To facilitate bringing off line bursts to the OT line, a range factor (d) in mils is employed by the observer. This factor is the angular deviation from the OT line caused by a 100-yard range change. The measured deviation of off line bursts is divided by this "d" to determine the number of 100-yard range bounds necessary to bring the bursts to the OT line. To determine this factor the observer measures the deviation in mils between ranging rounds and divides this angle by 4. When the observer is so close to the target that the use of angle measuring instruments is impracticable, he is able to estimate the amount of range change necessary in this case. His estimaion of range error is facilitated by the use of a ardstick" established by ranging rounds or by ther firing in the vicinity of his target.

b. The value of "d" may be determined also, approximately, by computation, using the formula:

$$d = \frac{1/10T}{r} \quad \text{(if T is less than 600 mils)}$$

145. **ADJUSTMENT. a.** The object of adjustment is to enclose the target within a deflection bracket of suitable width, with range correct, or to obtain target hits. This is accomplished by successively splitting the initial bracket.

b. Ranging rounds. Ranging rounds are normally employed to determine the S and d factors.

c. To get on the line. When a burst cannot be sensed positively for deflection because of its deviation from the OT line, the amount of deviation is measured in mils, and a range correction to place the next burst on the line is determined by dividing the deviation by d and multiplying by 100. For example: The observer senses deflection doubtful (80 mils right of the OT line); the d is 20; the piece is on the right. The range change to place the next burst on the line is 80/20 x 100 = 400 ards. The observer sends: ADD 400. It may be ecessary to bracket the line with range changes to secure line shots. Because of dispersion and irregular ground, it often may be difficult to obtain successive line shots. Minor deviations should be ignored unless it is impossible to obtain sensings.

d. To stay on the line. (1) When a line shot is obtained, a range change of 100 yards is made fo each S deflection change in order to keep the bur on the OT line. When a burst off the OT line sensed positively for deflection, the observer' range correction combines (a), the range chang to bring the off line burst to the line, and (b), th range change to stay on the line when the deflectio is changed. If the observer discovers that his factor is in error, he makes the necessary correction at any time during the adjustment.

(2) When a deflection bracket is obtained, it i split. Thereafter, bursts are kept on or near th OT line by splitting the range bracket betwee sensed rounds. If positive sensings cannot b obtained from bursts not on the OT line, th observer must modify the range bracket to brin off line bursts to the line, and then split the resulting bracket. An example of the procedure employe in keeping bursts on the OT line is as follows During adjustment a line shot has been obtaine and the observer sensed deflection short; he decide to shift the deflection 2 S's. S is 70; the piece is o the right. He commands RIGHT 140, ADD 20 The next burst is to the left of the OT line, bu he obtains a sensing of deflection over. With th use of the range factors, he determines that correction of DROP 40 would place the last burs on the OT line; therefore, he would consider hi range bracket to be 160 yards instead of 200 yard and his next correction should be LEFT 70 DRO 120 (DROP 40 to get on the line, DROP 80 to spl his effective range bracket of 160 yards). Thi correction should place the next burst on or ver

near the OT line. The brackets are narrowed until the bursts are brought within effective bursting radius of the target, or until the target is hit.

146. FIRE FOR EFFECT. a. Starting fire for effect. Fire for effect is started when a deflection bracket of 100 yards is split, or when target hits are obtained, or a salvo brackets the target for deflection.

b. Report of observer. Upon completion of fire for effect, the observer reports as in range-bracketing procedure.

147. EMPLOYMENT. a. Employ deflection-bracketing procedure when the observed deviation between ranging rounds is *greater than 200 yards* (target offset greater than 500 mils).

b. Bring bursts to the *OT* line by making appropriate *range* corrections.

c. Keep bursts on the *OT* line by making a 100-yard range change for each 1-*S* deflection shift.

148. PRECISION FIRE. a. Adjustment. The object of adjustment is to determine the *trial deflection.* The trial deflection is a deflection giving a target hit, or a deflection for the center of a 1-S bracket, or a deflection for the center of a bracket of 80 yards or less when *S* is greater than 80 yards.

b. Fire for effect. (1) Start fire for effect at the trial deflection, and with a range correction which will place the bursts on the *OT* line. The rounds are fired singly or in half-groups of three.

(2) Based upon positive deflection sensings, improve the deflection until it is correct. Deflection is correct when a target hit is obtained, when a 10-yard deflection bracket is split, or when *deflection over* and *deflection short* are obtained with the same deflection setting.

(3) Obtain and report to fire-direction center a group of six usable range sensings.

149. FLANK OBSERVATION. As the OT line approaches the perpendicular to the GT line, the observer must modify the procedure described above for staying on the line. The true value of S increases very rapidly as the observer's position approaches the flank of the target; for example, when the observer approaches to within 300 mils of the perpendicular to the GT line, the value of S has increased to approximately 340 yards. Based upon firing, the observer may find it necessary to make very small changes (or no change at all) in range to keep burst on the OT line when a deflection shift is made.

Section VI. CONDUCT OF THE BATTERY

150. GENERAL. This section is concerned with the various duties, operations, and requirements pertaining to the firing battery.

151. INITIAL LAYING. The executive (usually the platoon sergeant) lays the battery parallel initially and whenever he is ordered to record base deflection.

152. LAYING THE BATTERY PARALLEL.

a. Lensatic compass. The pieces are pointed in the general direction of fire. The battery executive places the compass on a stake or other support to steady it and commands: AIMING POINT, THIS INSTRUMENT. The gunner, upon locating the position of the compass, reports: "Aiming point identified." He then turns the elbow telescope in the direction of the compass. The executive measures the azimuth to the sight. He subtracts the azimuth on which the guns are to be laid from the azimuth which he has measured (adding 6400 if necessary). The remainder (minus 3200 if necessary) is placed on the sight. Without moving the sight, the tube is rotated until the sight is referred to the compass, at which time the gunner reports: "No. 1, Ready." The executive then commands: AIMING POINT_____: REFER, MARK BASE DEFLECTION. Without disturbing the tube, the sight is referred to the designated aiming point, and the base deflection recorded. This process may be repeated for each of the pieces of the battery or the remaining guns may be laid reciprocally.

b. Using aiming circle. The executive sets up an aiming circle away from magnetic metals and at a place where it can be used as an aiming point for ll pieces. He then—

(1) Subtracts from the declination constant plus 6400 if necessary, the azimuth on which the battery is to be laid.

(2) Sets the remainder on the azimuth and micrometer scales of the aiming circle.

(3) Release and center the compass needle using the lower motion. The 0–3200 line of the instrument is now directed to the announced azimuth.

(4) Reads the deflection to each gun with the upper motion and commands: AIMING POINT, THIS INSTRUMENT: DEFLECTION No. 1__, No. 2__, etc. (The gunner of each piece repeats this deflection and sets it on his sight. He then moves the tube so that the sight is referred to the aiming circle and repeats: "No. 1, ready for recheck." This process is repeated until the error has been reduced to one mil or less).

(5) Commands: AIMING POINT______: REFER: RECORD BASE DEFLECTION.

c. Reciprocal laying. When one gun has been laid in the proper direction by any method, the remaining guns of the battery may be laid on the same azimuth as follows: At the command ON NUMBER ______ LAY PARALLEL, the gunner of the specified gun turns his sight right or left, without disturbing the lay of the piece, until the vertical cross hair of his sight bisects the objective lens of the sight on the gun to be laid. He then takes the mil reading opposite the index on the deflection scale and announces it to the gunner of the gun to be laid. This gunner sets the announced reading on his own deflection scale, and without disturbing this reading, moves the gun in deflection until the vertical cross hair of his sight bisects the objective lens of the sight on the original gun. The first gunner checks his sight to see that rotation of the other gun has not thrown his sight off. If it has, he re-lays his sight on the sight of the other gun and announces the new ading. The second gunner sets the new reading on his sight and re-lays the gun so that his sight is back on the original sight. This process is repeated until a difference in reading of 1 mil or less is effected, at which time the second gun is parallel to the first.

153. **MINIMUM ELEVATION.** As soon as the position is occupied, the battery executive determines the minimum elevation for mask (and if necessary for troop) clearance (par. 165) and records this figure. In case it is necessary to determine more than one minimum elevation in the zone of fire, the executive records it, for example: Azimuth 4850 to 5200, minimum elevation 55; 5200 to 5650, minimum elevation 42.

154. **CONVERSION OF FIRE REQUESTS AND OBSERVER CORRECTIONS.** Firing data transmitted from the FO to the fire direction center is in yards for range and deflection. In order for this information to be of use to the gunner it must be converted to mils. The fire direction center converts yards of deflection to mils by means of he mil relation formula, a firing chart, or a deflec-on conversion table, and converts yards of range mils of elevation by means of a firing table.

155. **FIRE COMMANDS. a. General.** For general discussion of fire commands, see paragraph 95. The following subparagraphs discuss fire commands as applied to indirect fire.

b. Sequence. (1) The sequence for transmission fire commands for indirect fire is as follows:

(*a*) Pieces to follow commands.

(*b*) Type of ammunition.

(*c*) Fuze.

(*d*) Direction.

(*e*) Distribution.

(*f*) Pieces to fire.

(*g*) Method of fire.

(*h*) Elevation (the order to load the piece).

(*i*) Command to open fire.

(2) All fire commands follow the general sequence outlined above. However, in certain fire commands those elements which are not necessary for the proper conduct of fire are omitted.

c. Initial fire command. (1) *Pieces to follow commands.* When two or more guns are operating as a unit, the word BATTERY designates that all pieces are to follow commands. If it is desired that only one gun follow commands, the number of that gun is substituted.

(2) *Type of ammunition.* The type of ammunition to be used is specified in the fire command as: HE, HEAT, etc.

(3) *Fuze.* Unless otherwise specified, fuze superquick is used.

(4) *Direction.* Direction is indicated by BASE DEFLECTION or BASE DEFLECTION RIGHT (LEFT) (SO MUCH).

(5) (*a*) *Distribution.* This element deals with the distribution of the bursts in the impact area. To

close the sheaf the command is ON NUMBER____ CLOSE_____. To open the sheaf the command is ON NUMBER____OPEN____. The number of mils announced depends on the distance in yards that the bursts are to be moved and the range at which the battery is to fire. Upon receipt of this command, the gunners set off on their sights the product of the directed change and the number of intervals which exist between their pieces and the one designated, adding this product if the piece is to move to the left and subtracting if it is to move to the right. Then the gunners re-lay their pieces. Individual corrections to produce a regular sheaf are also included in this element of the fire command.

(*b*) *Definitions.*

1. *Sheaf.* A sheaf consists of the planes of fire of two or more pieces.
2. *Width of sheaf.* The width of the sheaf is the lateral interval between flank bursts.
3. *Parallel sheaf.* A parallel sheaf is one in which the planes of fire are parallel.
4. *Converged sheaf.* When the battery is fired with bursts converged on a point target, the planes of fire constituted converged sheaf (fig. 44).
5. *Open sheaf.* An open sheaf is one covering the maximum front without shifting. (Maxmum front is based upon the effective bursting radius of the HE shell).
6. *Regular sheaf.* A regular sheaf is one in which the bursts are approximately on a line for range and are equally spaced laterally.

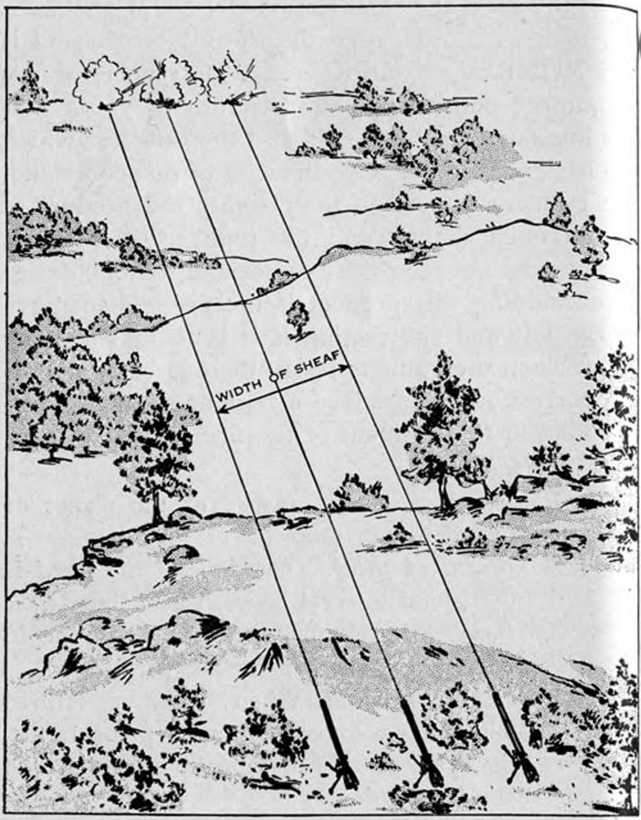


Figure 43. Parallel sheaf.

(6) *Pieces to fire.* This element of the fire command designates the specific weapon(s) which will fire.

(7) *Method of fire.* The method of fire is always announced in the initial fire command. If the battery is the fire unit, the command may be No. 1 (3, etc.,

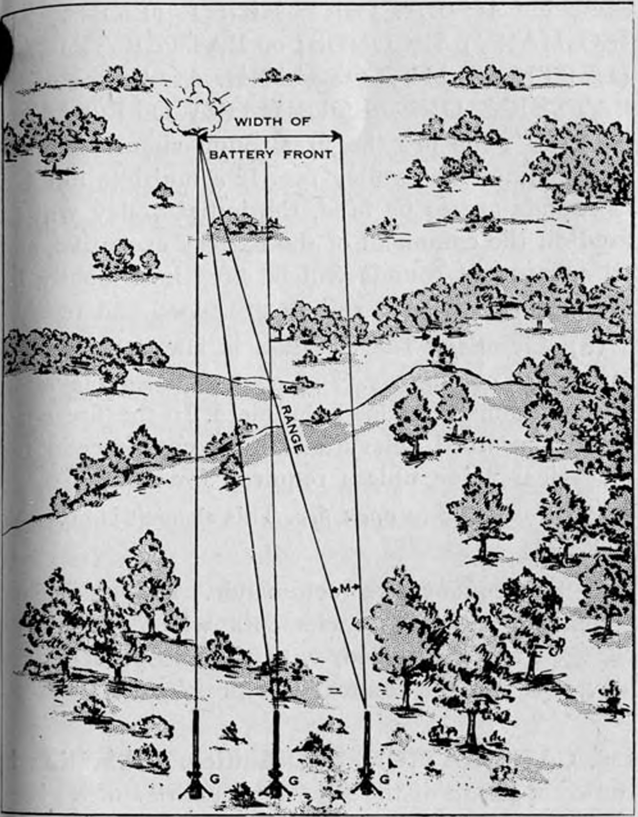

WIDTH OF
BATTERY FRONT
RANGE
M
G
G
G

Figure 44. Converged sheaf.

whichever is the base gun) ONE ROUND. At the command BATTERY RIGHT (LEFT), battery fire is delivered successively from the right (left) flank at short fixed intervals. The normal interval is 2 seconds. If a different interval is desired, the command is: BATTERY RIGHT (LEFT), AT (SO MANY) SECONDS; or BATTERY RIGHT (LEFT), AT MY COMMAND. At the command BATTERY ONE ROUND (TWO ROUNDS, etc.), all guns fire the first round simultaneously. This is known as volley fire. If a multiple number of rounds are to be fired, the initial volley will be fired on the command of the battery executive, and all subsequent rounds will be fired individually by each gunner as soon as he can re-load and re-lay.

(8) *Elevation.* The elevation is always announced in all fire commands. The command for elevation is the command to load the piece. In the fire command the word "elevation" does not precede the numerical value unless required for clarity.

(9) *Command to open fire.* This element is given as FIRE.

d. Subsequent fire commands. In subsequent commands only those elements which are to be changed are mentioned, with the exception of the elevation and the command to fire.

156. CALIBRATION. a. Definition. Calibration is the comparison of the shooting qualities of a given piece with those of another piece taken as standard. A calibration correction is a correction to make a piec[illegible] fire in agreement with the piece taken as standard.

b. Necessity for calibration. The principles of conduct of fire with a battery are based on the assumption that if all pieces of a battery are fired under the same conditions, the rounds will fall at approximately the same range. There are, however, variations due to slight differences in the dimensions of the chambers and in wear in the venturis. When the variations are determined by calibration, compensating corrections may be made.

c. **Method.** Calibration is normally accomplished by registration of the individual guns on a common target. (See par. 158.)

Section VII. PREARRANGED FIRES

157. GENERAL. a. Definition. (1) *Prearranged fires.* Fires for which firing data are prepared in advance are known as prearranged fires. Prearranged fires are used to aid in the support of an attack or defense, and for firing during periods of poor visibility or darkness. Normally they are unobserved fires. Concentrations should be prepared for gaps in the prearranged close-defensive fires of other supporting weapons, for likely avenues of approach, for possible assembly areas, for known enemy positions, and for areas which are likely to be occupied by enemy supporting weapons or observers. Requests for concentrations on gaps in the prearranged close-defensive fires of other supporting weapons will be given first priority over requests for all other types of fire.

(2) *Concentration.* A concentration is a volume of fire placed on an area within a limited time.

(3) *Registration.* Firing data will be corrected by registration on a known point, as near the time of firing as the tactical situation permits.

(4) *K.* The elevation correction factor obtained from registration on a base point is known as K (see par. 158).

(5) *Announcement of data.* Data determined by precise methods will be announced to the smallest graduation of the scale involved.

b. Direction. As prearranged fires are normally unobserved, the most precise methods of obtaining the initial data will be used, preferably by the employment of maps. If maps are not available, data will be obtained by the employment of fire control instruments and rapid plotting. When using maps, the positions of the gun and the target are determined and a line drawn connecting the two. The azimuth can then be measured directly with a protractor.

c. Angle of site. Computed as in paragraph 123.

d. Elevation. Determined as in paragraph 124.

e. New targets. New targets are plotted and the shift measured with a protractor.

f. Data cards. (1) Firing data are placed on a data card; a suggested form for such cards is shown in figure 45. Any other similar data card suiting the needs of the platoon or section leader is satisfactory.

(2) Upon the occupation of a position, these cards should be prepared for the primary positions, and when time permits, for alternate and supplementary positions as well.

(3) When a section (platoon) has a secondary target area, accurate data should be prepared for at least one concentration in that area.

Type of weapon 75-mm rifle

DATA CARD

AS, O-G −5 Mils

Location: 200 yds N. of CR 97

Min. QE for (mask) clearance: 88 Mils

(1) Concentration No.	(2) Location and description	(3) Time		(4) Range G-T	(5) Measured shift from BP	(6) Range O-T	(7) Meth of adj	(8) Shell	(9) Fuze	(10) BD	(11) DD on No. 2	(12) El K	(13) MF	(14) Corr El	(15) Remarks
		From	To	Elevation	Magnetic azimuth	SI, O-T									
75 1	Bushy tree center of field	On call		2000 111	 1,600	1000 5		HE		BD		+4	No. 3 (1)	115	
75 2	Cross roads Left front	On call		2500 143	L20	1500 −10		HE		L20	CL20	+4	B (3)	147	

BD—Base deflection.
DD—Deflection difference.
MF—Method of fire.
BP—Base point.
(1) or (2) 1 round or 3 rounds, etc.
Btry—Battery.
R—Right.
L—Left.
HE—High explosive.
SQ—Superquick.
EL K—Elevation constant.
Corr El—Corrected elevation.

Figure 45. Sample data card.

g. Notes on data card (fig. 45). Concentrations for the 75-mm rifle are identified by the number 75 followed by the number of the concentration. The following subparagraphs are numbered to correspond to similarly numbered columns on the suggested data card.

(1) Requests for fires are made by requesting "Concentration No. ( )", or in accordance with a prescribed signal.

(2) In identifying a target, its location and description are included (when necessary).

(3) Time of fire is indicated in this column. Signals (if used) for firing particular concentrations are also included.

(4) The range, GT, is entered as measured; below it is entered the corresponding elevation in mils. When the range GT, as measured, is other than in even 100 yards, the elevation is obtained by interpolation.

(5) Angles of shift measured at the OP from the base point, and azimuths to the centers of the various concentrations, are entered in this column. Azimuth to the base point is always shown.

(6) The range, OT, and the angle of site, OT, are entered in this column to permit ready substitution in the mil relation. This column is employed in firing from defilade.

(7) This column may show the method of adjustment.

(8) This column specifies the type of projectile; this and the data in the columns to the right form the basis for the necessary fire commands.

(9) The fuze setting is indicated only when it is o be DELAY.

(10) The angle of shift for the guns from base point to target is entered in this column.

(11) If a command to close the fires is required, it is inserted in this column. No. 3 gun is normally the base piece.

(12) The elevation constant (K) is entered in this column.

(13) The method of fire, including the number of rounds, is shown.

(14) The corrected elevation (see par. 124), determined from adjustment on the base point, is entered in this column.

(15) In this column are entered remarks, such as elevations for zone fire or other pertinent data.

158. **CORRECTED ELEVATION.** In prearranged fires a range correction, based on registration, should be applied to the elevation determined for the various concentrations. The correction to be applied is directly proportional to the range, and is illustrated by the following example (data determined by rapid plotting methods):

Range to base point.............2,000 yards
Elevation to base point........... 111 mils
Adjusted elevation to base point... 104 mils

Always subtract the initial elevation (111) from the adjusted elevation (104) to determine the sign of the correction. A correction without a sign, plus or minus, is worthless; 104 — 111 equals — 7 mils, correction at 2,000 yards. The correction is always expressed as plus or minus (so many) mils per thousand yards. Therefore, in the example th correction would be – 3.5 mils per 1,000 yard This correction is known as K. Because of unequal wear in the vent, bushings, and other factors, the K of a gun will change. Because of this change, accurate firing records must be kept on all pieces. The K determined is limited to the ammunition lot and weight of projectile used in the base point registration from which it was determined. It can be applied to any elevation provided the atmospheric conditions have not materially changed and the same maps or instruments have been used in determining the data.

159. OVERLAYS. Upon occupation of an indirect fire position, the platoon leader prepares an overlay or sketch (fig. 46) which shows for each section, when separated from the platoon, or for the platoon: positions, base point, concentrations prepared for known enemy positions, routes, and landmarks. It may, in addition, indicate routes between the front lines and the rear of the battalion area. The usual means for orienting an overlay by coordinates are provided. Overlays or sketches showing the locations of guns and concentrations are sent to the supported unit commander and to the compan commander. The latter combines them in a sketc showing the fire plan of the company. Concentrations for which data have been prepared are drawn to scale with circles of 100 yards diameter; each circle contains the number of the concentration, preceded by the designation 75.

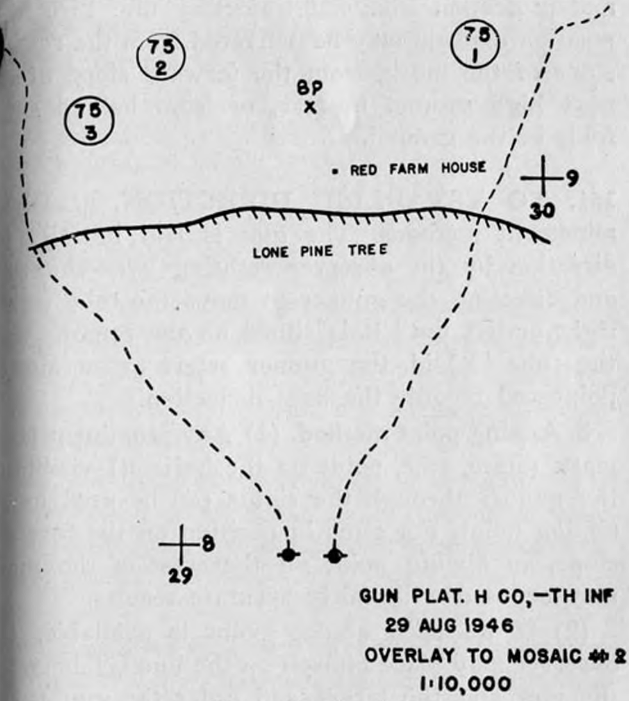

75
2
75
1
BP
X
75
3
RED FARM HOUSE
9
30
LONE PINE TREE
8
29
GUN PLAT. H CO,—TH INF
29 AUG 1946
OVERLAY TO MOSAIC #2
1:10,000

Figure 46. Overlay.

Section VIII. POSITION DEFILADE

50. **GENERAL.** This section is concerned with determination of initial fire data and adjustment when the gun is fired from position defilade. When the gun and its crew are hidden from the target, but an observer at or near the gun can see the target, the gun is said to be in position defilade; such a firing position normally implies concealment

and protection from flat trajectory fire. Fire fro position defilade may be delivered from the rever slope of the mask, from the forward slope of the next high ground in rear, or from behind small folds in the ground.

161. TO ESTABLISH DIRECTION. a. Direct alinement methods. The gun is laid initially for direction by the observer sighting over the tube and directing the gunner to move the tube to the right or left until it is alined on the target. After the tube is laid, the gunner refers to an aiming point and records the base deflection.

b. Aiming point method. (1) Any prominent landmark (spire, tree, point on the horizon) visible to the gunner through the sights can be used as an aiming point. For guns in position on the forward slope, an aiming point on the crest of the mask may be used with fairly accurate results.

(2) If no such aiming point is available, the observer may place himself on the line GT between the gun and the target and order the gun to be laid on him with a deflection setting of zero. After the gun is laid for direction by these methods, the gunner refers to an aiming point (or aiming post) and records the base deflection.

(3) The selected aiming point may be off t line GT if some means is at hand to measure the deflection, such as a compass, binoculars, or aiming circle. The corresponding deflection is set on the elbow telescope M62 as follows: If the aiming point is to the left of the line GT, the gunner sets a right deflection equal to the deflection announced;

if the aiming point is to the right, the gunner sets a left deflection equal to the announced deflection. In either case he lays on the aiming point.

(4) After the initial burst the observer adjusts for deflection by transmitting direct to the gunner the measured deviation between the burst and the target.

162. ANGLE OF SITE. a. The angle of site to the target may be measured with binoculars (par. 27) or aiming circle (par. 30), or it may be estimated.

b. If the elevation of the target is nearly the same as that of the gun, the angle of site can be considered as zero.

c. When the observer is not at the gun position, he selects a point as far above the target as he is above the gun and measures the angle of site to that point.

163. ELEVATION. a. The range GT is determined from maps, fire control instruments, estimation, or from friendly troops. The angle of elevation corresponding to that range is found in the firing tables.

b. The angle of site GT and angle of elevation at GT range are added together algebraically and the resulting figure is known as Quadrant Elevation. This figure is placed on the elevation quadrant.

c. Minimum elevation for mask clearance (for very short distances only) is determined by sighting along the bottom of the bore and elevating the piece until the line of sight just clears the mask. The longitudinal level bubble on the sight is then levelled by turning the micrometer knob on the sight, and the minimum elevation for mask clearance is read directly from the elevation scale and micrometer.

d. Adjustment for elevation is conducted in accordance with the provisions of section III, this chapter.

164. NEW TARGETS. After having adjusted on an initial target, fire may be readily shifted to new targets. The angle of shift is measured with binoculars and applied directly to the piece.

Section IX. EXTRACT OF FIRE CONTROL TABLES

165. MASK AND TROOP CLEARANCE. a. Mask clearance. The minimum quadrant elevation for mask clearance is the minimum elevation at which the gun can be fired with assurance that every round will clear the mask. It is computed by adding the angle of elevation for gun-mask range plus two forks (eight range probable errors), to the angle of site from gun to mask (fig. 47). Mask clearance elevations for various ranges can be determined by adding the angle of site, gun to mask, to the figure in column IV, opposite the proper range, in table VII.

b. Troop clearance. Minimum quadrant elevation for troop clearance is the minimum elevation at which the gun can be fired with assurance that troops on the mask will be safe. It is computed

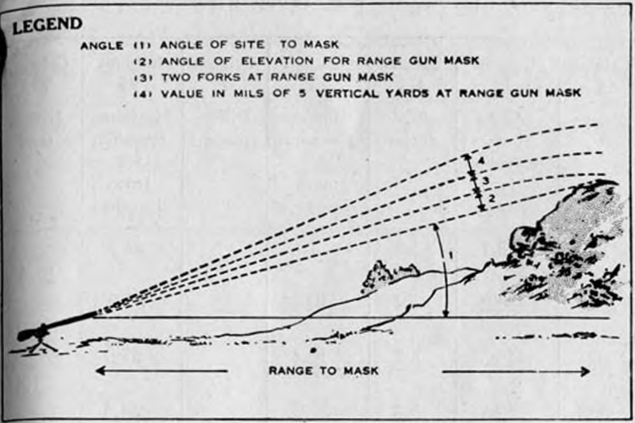

LEGEND
ANGLE (1) ANGLE OF SITE TO MASK
(2) ANGLE OF ELEVATION FOR RANGE GUN MASK
(3) TWO FORKS AT RANGE GUN MASK
(4) VALUE IN MILS OF 5 VERTICAL YARDS AT RANGE GUN MASK
4
3
2
1
RANGE TO MASK

Figure 47. Mask and troop clearance.

by adding to the minimum quadrant elevation sufficient additional elevation to raise the trajectory an additional five vertical yards over the mask (fig. 47). This additional elevation can be computed from the mil relation formula. Troop clearance elevations for various ranges can be determined by adding the angle of site, gun to mask to the figure in column VI, opposite the proper range in table VII.

c. Mask and troop clearance table.

Note. The angle of site to the mask or troops must be added to the values in columns IV and VI to obtain the minimum quadrant elevation for mask and troop clearance. "C" factor is the change in elevation for a 100-yard change in range.

Table VII. Mask and Troop Clearance Data

Column I Range	Column II Angle of elevation for Range	Column III "C" factor	Column IV Minimum elevation for mask clearance	Column V Difference	Column VI Minimum elevation for troop clearance	Column VII Difference
100	5.1	5.1	5.5		55.5	
				5.4		19.4
200	10.2	5.1	10.9		35.9	
				5.5		2.9
300	15.3	5.2	16.4		33.0	
				5.5		1.4
400	20.5	5.2	21.9		34.4	
				5.6		3.1
500	25.7	5.3	27.5		37.5	
				5.6		3.9
600	31.0	5.3	33.1		41.4	
				5.7		4.5
700	36.3	5.4	38.8		45.9	
				5.7		4.8
800	41.7	5.4	44.5		50.7	
				5.8		5.0
900	47.0	5.5	50.3		55.7	
				5.8		5.4
1000	52.5	5.5	56.1		61.1	
				5.9		5.4
1100	58.0	5.6	62		66.5	
				6.0		5.6
1200	63.6	5.7	68		72.1	
				6.1		5.9
1300	69.3	5.7	74.1		78	
				6.2		5.8
1400	75.0	5.8	80.3		83.8	
				6.3		6.1
1500	80.8	5.8	86.6		89.9	
				6.4		6.2

Table VII. Mask and Troop Clearance Data—Continued

Column I Range	Column II Angle of elevation for Range	Column III "C" factor	Column IV Minimum elevation for mask clearance	Column V Difference	Column VI Minimum elevation for troop clearance	Column VII Difference
1600	86.7	5.9	93		96.1	
				6.4		6.2
1700	92.6	6.0	99.4		102.3	
				6.5		6.4
1800	98.6	6.0	105.9		108.7	
				6.6		6.4
1900	104.7	6.1	112.5		115.1	
				6.7		6.6
2000	110.9	6.2	119.2		121.7	
				6.8		6.7
2100	117.2	6.3	126		128.4	
				6.9		6.8
2200	123.5	6.3	132.9		135.2	
				6.9		6.8
2300	129.9	6.4	129.8		141.9	
				7.1		7.0
2400	136.4	6.5	146.9		148.9	
				7.2		7.2
2500	143.0	6.6	154.1		156.1	
				7.3		7.2
2600	149.7	6.7	161.4		163.3	
				7.5		7.4
2700	156.4	6.8	168.9		170.7	
				7.6		7.6
2800	163.2	6.9	176.5		178.3	
				7.7		7.6
2900	170.2	7.0	184.2		185.9	
				7.9		7.8
3000	177.3	7.1	192.1		193.7	
				8.0		8.0

Table VII. Mask and Troop Clearance Data—Continued

Column I Range	Column II Angle of elevation for Range	Column III "C" factor	Column IV Minimum elevation for mask clearance	Column V Difference	Column VI Minimum elevation for troop clearance	Column VII Difference
3100	184.5	7.2	200.1		201.7	
				8.2		8.1
3200	191.7	7.3	208.3		209.8	
				8.3		8.3
3300	199.0	7.4	216.6		218.1	
				8.5		8.4
3400	206.5	7.5	225.1		226.5	
				8.6		8.6
3500	214.1	7.6	233.7		235.1	
				8.8		8.8
3600	221.8	7.7	242.5		243.9	
				8.9		8.8
3700	229.6	7.9	251.4		252.7	
				9.0		9.0
3800	237.5	8.0	260.4		261.7	
				9.2		9.1
3900	245.6	8.1	269.6		270.8	
				9.3		9.3
4000	253.8	8.2	278.9		280.1	
				9.5		9.5
4100	262.2	8.4	288.4		289.6	
				9.7		9.7
4200	270.7	8.6	298.1		299.3	
				9.9		9.8
4300	279.4	8.8	308		309.1	
				10.1		10.1
4400	288.2	8.9	318.1		319.2	
				10.3		10.3
4500	297.2	9.1	328.4		329.5	
				10.7		10.7

Table VII. Mask and Troop Clearance Data—Continued

olumn I Range	Column II Angle of elevation for Range	Column III "C" factor	Column IV Minimum elevation for mask clearance	Column V Difference	Column VI Minimum elevation for troop clearance	Column VII Difference
4600	306.3	9.3	339.1		340.2	
				10.9		10.9
4700	315.7	9.6	350		351.1	
				11.2		11.1
4800	325.4	9.8	361.2		362.2	
				12.0		12.0
4900	335.4	10.1	373.2		374.2	
				12.3		12.3
5000	345.6	10.3	385.5		386.5	
				12.6		12.5
5100	356.1	10.6	398.1		399	
				13.0		13.0
5200	366.9	10.9	411.1		412	
				13.3		13.3
5300	378.0	11.3	424.4		425.3	
				13.8		13.8
5400	389.4	11.6	438.2		439.1	
				14.5		14.5
5500	401.2	12.0	452.7		453.6	
				15.3		15.2
5600	413.5	12.5	467		468.8	
				16.0		16.0
5700	426.3	13.0	484		484.8	
				17.1		17.1
5800	439.6	13.6	501.1		501.9	
				18.0		18.0
5900	453.5	14.3	519.1		519.9	
				18.8		18.8
6000	468.1	15.0	537.9		538.7	

166. DEFLECTION CONVERSION TABLE. For deflection conversion data, see table VIII below.

Table VIII.—Deflection Conversion Table (from yards to mils)

Range in yards	Deflection in yards														
	1	10	20	30	40	50	75	100	125	150	175	200	300	400	500
500	2.0	20	41	61	81	102	152	201	250	297	343	388	550	687	800
600	1.7	17	34	51	68	85	127	168	209	250	289	328	472	599	708
700	1.5	15	29	44	58	73	109	145	180	215	250	284	412	529	632
800	1.3	13	25	38	51	64	95	127	158	189	219	250	365	472	569
900	1.1	11	22	34	45	57	85	113	141	168	195	223	328	426	517
1000	1.0	10	20	31	41	51	76	102	127	152	176	201	297	388	473
1100	.93	9	18	28	37	46	69	92	115	138	161	183	271	355	435
1200	.85	8	17	25	34	42	64	85	106	127	148	168	249	328	402
1300	.79	8	16	23	31	39	59	78	98	117	136	155	231	304	374
1400	.73	7	15	22	29	36	55	73	91	109	127	145	215	283	349
1500	.68	7	14	20	27	34	51	68	85	102	118	135	201	265	328
1600	.63	6	13	19	25	32	48	64	80	95	111	127	189	250	309
1700	.60	6	12	18	24	30	45	60	75	90	104	119	178	235	291
1800	.57	6	11	17	23	28	42	57	71	85	99	113	168	223	276
1900	.54	[illegible]	11	16	21	27	40	54	67	80	94	107	160	211	[illegible]

2000	.51	5	10	15	20	25	38	51	64	76	89	102	152	201	250
2100	.49	5	10	15	19	24	36	48	61	73	85	97	145	192	238
2200	.46	5	9	14	19	23	35	46	58	69	81	92	138	183	228
2300	.44	4	9	13	18	22	33	44	55	66	77	88	132	175	218
2400	.43	4	8	13	17	21	32	42	53	63	74	85	127	168	209
2500	.41	4	8	12	16	20	31	41	51	61	71	81	122	162	201
2600	.39	4	8	12	16	20	29	39	49	59	68	78	117	155	194
2700	.38	4	8	11	15	19	28	38	47	57	66	75	113	150	187
2800	.37	4	7	11	15	18	27	36	45	55	64	73	109	145	180
2900	.35	4	7	11	14	18	26	35	44	53	61	70	105	140	174
3000	.34	3	7	10	14	17	25	34	42	51	59	68	102	135	168

Note. This table gives the true values of angles subtended by the distances shown in the first horizontal column at the ranges shown in the first vertical column. The angles were computed using the trigonometric function of the angle—**the tangent of the angle. This table may be used without regard to the size of the angle.**

Section X. RECORDERS SHEET

167. GENERAL. Each battery of guns should have a recorder whose duty it is to keep a complete written account of all fire commands—initial and subsequent—that are issued, so that at any time he can verify the deflection or elevation settings, the type of ammunition being used, the method of fire, or any other element of the fire command.

168. SAMPLE FORM. Figure 48 illustrates a suggested form for tabulating current fire data. Any other similar data form suiting the needs of the battery is satisfactory. Headings on the columns from left to right follow generally the sequence of the fire command. After the initial command, entries are made only in those columns which are changed by the subsequent commands. The last entry in any column is the current status of the guns with respect to the element of the fire command represented by the heading of that column. The first column deals with the pieces which are to follow the commands. The second column will indicate the type of projectile to be fired. The third column will be used only in the event HE ammunition is to be fired as this is the only ammunition on which a fuze setting may be made. The notation will be either SQ (superquick) or DELAY. The fourth column will indicate the number of mils change in deflection the guns are to effect before the next rounds are fired; individual corrections for a particular gun are entered here also. The fifth column will show which guns are to fire; in what order

RECORDER SHEET

Pieces to follow	Shell	Fuze	Defl. shift	M/F	Elev	Gun 4	Gun 3	Gun 2	Gun 1	Am status	Remarks
BTRY ADJUST	WP		BD	#3 (1)	130	3182	3146	3109	3069	HE 83 WP 21	
	HE		L–20	#3 (1)	143	0002	3166	3129	3089	HE 82 WP 21	
			R–10	#3 (1)	136	3192	3156	3119	3079	HE 81 WP 21	
	HE	Delay		BTRY LEFT	136	3192	3156	3119	3079	HE 78 WP 21	#2 OUT
	HE		No. 4 R3		Nos. 1, 2 & 4 136 No. 3, 140	3189	3156	3119	3079	HE 75 WP 21	

Figure 48. Suggested recorders sheet.

they are to fire, and at what time; that is, BATTERY RIGHT, AT MY COMMAND: or, BATTERY 3 ROUNDS. The sixth column will contain the corrected elevation. The numbers in the next four columns are the numbers of the guns. In addition, each numbered column will contain the corrected deflection for the corresponding numbered gun. The last two columns are used for the number of rounds remaining at the battery position, and remarks, respectively.

Section XI. SUBCALIBER TRAINING ON LANDSCAPE TARGETS AT UNKNOWN SHORT RANGES

169. SCOPE AND IMPORTANCE. Indirect laying on landscape targets at unknown short ranges provides a convenient method of training observers, squad leaders, and gun crews in the principles of battery fire. This type of training may be given in indoor ranges or on miniature outdoor ranges where range facilities are not adequate for field firing. It permits close supervision of all members of the firing unit, develops teamwork, and arouses a competitive spirit among the participants. It clearly and quickly demonstrates the application and effect of fire and prepares gunners for field firing.

170. TARGETS, RANGE INDICATIONS, DIRECTION CARDS, SCORING DEVICES. See paragraphs 104 and 105. Targets are mounted with the bottom of the target three feet above the ground.

171. **INSTALLATION OF GUNS.** The battery is located at an unknown range from the targets. Guns are mounted as close to the ground as the tripod permits. Gun intervals are reduced to the minimum. A screen (representing a mask) is set up before the actual problem starts, in front of the battery in order to prevent the gunners from observing the target while laying. Bullets pass through, rather than over, the mask.

172. **ZEROING THE RIFLES.** The rifles are boresighted for indirect fire as prescribed in paragraph 59**b**. A round is then fired at a zeroing paster on the target. The tube remains stationary and the sight is then referred until the vertical cross hair of the reticle is alined on the hole made by this shot.

173. **BASE POINT ADJUSTMENT.** **a.** Upon completion of the operation above, select a vertical line on the target. The edge of the target is satisfactory. Traverse the tube until the vertical cross hair of the reticle is alined on this vertical line. All guns are alined on this same vertical line and the battery converges on that line. All sights are now referred to a selected aiming point to the flank or rear of the gun position. Gunners read and record initial base deflection.

b. Select a base point on the landscape target, and register with the base gun. All guns are then adjusted on the target (base point). Elevations and deflections are recorded. The battery is then opened by the command ON NO.___. OPEN___ MILS. (The number of mils will depend on the range to the targets and the desired width of sheaf.) Gunners now read and record deflection to the base point. This becomes the adjusted base deflection.

c. During the adjustment for deflection, adjustments are also made for elevation. A mean elevation is taken as the adjusted elevation for the battery, with each gun having a correction factor. For example, in adjusting on the base point, the following elevations were found correct: No. 1–12, No. 2–6, No. 3–8, No. 4–9 mils. The elevations vary from 6 mils to 12 mils, the mean elevation being 8 mils. The battery elevation is then taken as 8 mils. Each gun, except No. 3, will now have an individual correction factor for elevation as follows: No. 1, drop 4; No. 2, add 2; No. 3, no change; No. 4, drop 1. These are constants and are applied individually thereafter to the announced battery elevation.

174. CONDUCT OF THE PROBLEM. An OP is established at a position on one flank. The observer is given the location of the base point and the elevations and deflections thereto. He is given a target on which to adjust and fire for effect. Upon completion of his mission, a critique is held by the officer conducting the firing. Duties are then rotated among gunners, squad leaders, and observers.

175. FIRING AT FIELD TARGETS FROM DEFILADE POSITIONS. For field firing exercises see paragraph 114.

CHAPTER 7

ADVICE TO INSTRUCTORS

Section I. GENERAL

176. PURPOSE. The purpose of this chapter is to aid the instructor in the organization, preparation, and presentation of necessary instruction to provide adequate training for recoilless weapons units. It is not to be considered as having the force of regulations, but is presented only as a guide.

177. TRAINING AIDS. Training aids which will facilitate instruction are suggested below.

a. Nomenclature boards.

b. Charts. (1) Breech mechanism.

(2) Phases of functioning.

(3) Stoppages and immediate action.

(4) Ammunition and fuzes.

(5) Acetate sight reticles (large).

(6) Acetate sight envelopes.

(7) Aiming circle M1.

(8) M7 and M9 range finders.

(9) M34 sight.

(10) M10 plotting board.

(11) Position defilade.

(12) Indirect fire.

c. Models. (1) Breech mechanism.

(2) Mask clearance.

(3) Gunner's rule.

(4) Parallel laying.

(5) Puff boards.

178. ASSISTANT INSTRUCTORS. Sufficient numbers of selected enlisted instructors should be trained, to include qualification firing, prior to conducting unit training.

179. DEMONSTRATION GROUPS. Outstanding assistant instructors should be selected and trained as special demonstration groups. Constant practice and rehearsals should eventually result in teams which can coordinate with the instructor in attaining split-second timing. Demonstration groups should emphasize training in the following:

a. Demonstration section organization.

b. Demonstration of crew drill.

c. Boresighting (direct and indirect fire sights).

d. Firing demonstrations:

(1) Targets (varying ranges previously determined by instructor).

(2) Box demonstration (safety).

(3) Position defilade.

(4) Battery fire (4 guns).

(5) Landscape firing (subcaliber).

(6) Transition firing (subcaliber).

Section II. MECHANICAL TRAINING

180. ORGANIZATION. The unit to be instructed should be divided into section groups, each group under the supervision of an assistant instructor, with gun, tools, and equipment assembled in a suitable area. Instruction is centralized under the principal instructor. Explanation and demonstration, by phases, are concurrent. Practical work will be conducted by assistant instructors. Subjects to be covered during this phase of training are general data, nomenclature, disassembly, assembly, functioning, stoppages, immediate action, care and cleaning, destruction of materiel, ammunition and fuzes.

181. NOMENCLATURE, DISASSEMBLY AND ASSEMBLY. a. Equipment necessary per group:

1 gun.
1 tripod.
1 set Allen wrenches.
1 set cleaning equipment.

b. Procedure. (1) Assistant instructors will disassemble and assemble the gun while the principal instructor explains proper methods.

(2) After disassembly, the assistant instructors will number each man in their groups. The principal instructor will name various parts of the gun while the assistant instructor appoints various numbered men to point out these parts.

(3) The principal instructor will turn guns over to assistant instructors, who will conduct practical work.

(4) The principal instructor will question the men.

182. FUNCTIONING. a. Equipment. As listed in paragraph 181**a**, plus charts and models of breech mechanism.

b. Procedure. The principal instructor will outline and explain various phases of functioning while the assistant instructors demonstrate.

183. STOPPAGES AND IMMEDIATE ACTION. a. Equipment. 1 gun and equipment listed in paragraph 181**a**, charts on stoppages and immediate action.

b. Procedure (1) Actual stoppages should be set up and reduced by assistant instructors.

(2) Emphasize caution in performing immediate action.

184. CARE AND CLEANING AND DESTRUCTION OF MATERIEL. a. Equipment. Waste, oil, bore cleaner, crocus cloth, rammer staff, Allen wrenches.

b. Procedure. (1) Stimulate interest in care and cleaning; cite combat examples of poor and improper maintenance.

(2) Demonstrate points to be observed before, during, and after firing the gun.

(3) Point out the various methods of destroying the gun; that is, use of grenades, shells, explosives, etc.

185. AMMUNITION AND FUZES. a. Equipment. (1) Dummy or drill round for each group.

(2) Rounds of each type for principal instructor.

(3) Cutaway models of shells and fuzes.

(4) Charts and diagrams of ammunition and fuzes.

b. Procedure. (1) Point out various specific characteristics of ammunition and compare with conventional artillery type ammunition.

(2) Explain workings of fuzes, using cutaway models or charts.

(3) Explain uses and effects of various types of projectiles.

Section III. CREW DRILL

186. EQUIPMENT. T/O & E equipment for the section.

187. PROCEDURE. Instruction in crew drill should be followed by demonstrations by a trained drill section. Perfection in team work is the goal of crew drill. Sections should be moved to their guns for practical work. Initial emphasis should be placed on precision: After the assistant instructor is satisfied with the performance of each individual in all phases, then practice can be instituted toward speed competitions between sections. Each phase of crew drill should be accompanied by the issuance of a fire command and the simulated engagement of a target. Advanced crew drill can be accomplished by training sections in position defilade technique.

Section IV. MARKSMANSHIP

188. GENERAL. The instructor who delivers lectures and conferences to the men should be held responsible for the conduct of firing. He should apply the explanation, demonstration, and application phases of instruction at all times.

189. ORGANIZATION **a.** Proper allocation of time and personnel must be carefully checked during marksmanship training.

b. A schedule of instruction should be adhered to during all phases of marksmanship training. A careful check must be made on the progress of the men, and the duties of the various members of the section should be rotated.

c. Subjects which should be covered are as follows: fire commands, sighting and aiming, position exercises, tracking, trigger manipulation, range estimations, speed and lead determinations, triangulations, boresighting, subcaliber devices, targeting, and safety precautions.

d. Conduct of fire with service ammunition should be rigidly controlled. Assistant instructors should be at each gun and a safety officer at each 6 guns. Firers should leave their guns only on command from the principal instructor, who is also control officer. Only a gunner and loader should be present at the gun during firing.

e. Ammunition should be prepared prior to firing, left in boxes, and spotted at the right front of gun. An officer should inspect ammunition for the following:

(1) Rotating band clean and not burred.

(2) Lack of rotation of projectile in casing.

(3) Propellent container paper not punctured.

Section V. FIELD FIRING

190. GENERAL. Proper analysis of terrain, use of camouflage, selection and occupation of firing positions, fire commands, fire discipline, and control are assential to proper instruction in field firing.

191. EQUIPMENT. T/O & E; ammunition as authorized by current regulations.

192. PROCEDURE. a. Preparation. Construction of a proper range and/or correct placement of targets is a duty of the principal instructor.

(1) Ranges should allow for direct and indirect fire problems.

(2) Targets should be numerous, varied in type, and camouflaged. Some suggested types are as follows: Log emplacements, 55-gallon oil drums, cave type emplacements, armored vehicles, prone and kneeling silhouettes arranged in tactical formations, dummies (snipers in trees, house windows, etc.).

b. Firing. As the section prepares to fire, the section leader should be oriented as to the location of the camouflaged targets. He should bring his section to the firing position, taking advantage of cover and concealment, and issue his fire command. The section leader should use considerable latitude in his selection of ammunition types, and should fit ammunition combinations to particular targets. Speed in occupation of position, firing, and movement to alternate positions should be stressed.

c. Critique. The principal instructor should point out the difficulties encountered during firing, outstanding errors, and methods of correcting those errors. He should be particularly careful to maintain team spirit by commending good work. He should constantly stress the type of target in use and the ammunition combinations used to reduce those targets, emphasizing battlefield application.

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